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WIRELESS TELEGRAPHY.

A recently published communication from Prof. Fleming makes it apparent that the art of wireless telegraphy is passing out of the single-message stage and entering the region of simultaneous multiple telegraphy. It seems that Mr. Marconi has exhibited two independent circuits between a pair of stations 30 miles apart, one on the Isle of Wight and the other near Poole, on the opposite coast of England. Two messages were forwarded simultaneously from St. Catharine's, on the Isle of Wight, and both were simultaneously and independently received at Poole, using the same receiving vertical wire, about 40 ft. in height. In the absence of definite information to the contrary, there is no necessity for believing that this independence was due to syntony or electric tuning; it may possibly have been effected otherwise. A separate cable dispatch implies advances in tuning. Another important result communicated by Prof. Fleming has been the diminution of the necessary elevation of the antennæ. These have usually consisted of vertical wires supported by wooden masts. It is stated that by the use of vertical metal cylinders equally good results can be obtained with a reduced elevation, so that 30 miles of distance can be transmitted over with cylinders 25 or 30 ft. above the ground at each of the two stations.

AN OLD TIMER

An interesting and picturesque figure has just passed away in the person of Mr. U. H. Painter. We take it from observation that he is utterly unknown to the present generation of electrical engineers and companies, yet it may be said almost without any exaggeration that at various times he held the future of the Bell telephone, the Edison phonograph and the Sprague motor in the hollow of his hand. In other words, with the prompt intuitions of an unusually able journalist he was quick to see electrical possibilities and to pledge his own money and secure other financial support for new ideas. Along the line of industrial development higher praise than that could hardly be bestowed, for all the world honors the pioneer. Yet Mr. Painter was more than a speculator in great inventions. As a war journalist he had the private ear and confidence of President Lincoln; as a publicist he had the history and traditions of Congress by heart; and, as one other curious side to his complex nature, he was a patron of the drama and a builder of theatres. Having had the pleasure of a close personal acquaintance with this singular genius in the early electrical days when the telephone, electric lighting and electric power arts were in their struggling infancy, we cannot refrain from this passing tribute to his memory. There are few such men now left, even in the electrical ranks, whose record touches all these beginnings.

AUTOMOBILE SPORT.

Every one interested in the welfare of what is destined to be at once a great new pastime and a great new industry, must take pleasure in the prosperity of the Automobile Club of America, which is aiming to do in this country what kindred national clubs have already undertaken in France, England and other European countries. The annual meeting, this week, with its reports of growth and work, is an encouraging indication of the genuine public interest in the subject and a recognition of the good that such a club can do. There are rules of sport to formulate; there are details of standardization to establish; there are roads to create and perfect; there are legal aspects of automobilism to be watched; and in all these respects the club has its work cut out already and has taken up its responsibilities. It was to

us a hopeful sign that so many electrical men participated in the meeting and stand ready to work for the club; and we can assure President Shattuck of substantial support from the electrical industries. It must be obvious that the club occupies to-day an enviable position, able to promote the sport on behalf of amateurs, and at the same time is influential with manufacturers and all who will use the automobile for pleasure or business. We hope to see the social side of the club strengthened, although we think it would be a great pity if in this respect it went as far as the Automobile Club of France, where an excess of devotion to mere dining and wining to the exclusion of more serious matters drove out a great many, who, while they are gentlemen and sportsmen, could not forget that as manufacturers the welfare of a great art was at stake in their hands. Here with us, it would seem that a thorough harmony of all tastes and interests can be maintained by the club.

THE ELECTRIC VEHICLE VERSUS THE HORSE—A COMPARISON.

In the final installment of the report on "The Electric Automobile from a Commercial Point of View," published in this issue, we find, for the first time, a very close comparison made between the actual cost of horse and electric traction on common roads. We believe that this is the first close comparison that has been attempted in which the full depreciation and repair charges for the electric system have been considered by a perfectly impartial investigator. The four tables in this part of the report we commend to the special attention of our readers, for it is only by a careful study of them that much of the information which they contain can be extracted. Of course, we all appreciate the fact that cost is not the only thing to be considered when we are inquiring into the commercial value of a new system—in fact, many other points may quite overshadow it. If it can be shown, however, that a new "proposition" can justly claim among its other advantages that of equal or less cost over an old system, its ultimate success in the commercial world with the hard-headed business men who dominate it is practically assured.

It is pointed out to us to-day that when the electric vehicle is given *proper attention* and *care* it should be able to do the work required of horses and wagons engaged in light delivery service in the Borough of Manhattan at practically the same cost for the same service. At first blush this conclusion may be a lame and disappointing one to some of our readers, but, when they think what a remarkable showing this really is for an industry that has hardly put off its swaddling clothes as yet, we feel sure that they will join with us most heartily in extending felicitations to those to whose energy and perseverance such a showing, at this early stage in the development of the electric automobile for commercial purposes, is possible.

The many advantages which the electric system of propulsion on common roads has over the present horse system have been exploited so often that any repetition of them in these columns would be superfluous. One of the advantages which are always claimed for them, however, is that of greatly increased speed over the horse system. That speed in the case of an electric vehicle is purely a matter of design we all know, but it is not as generally recognized that this advantage at the moment is more theoretical than practical in commercial service. For, though an electric vehicle may have a possible speed of, say, 15 to 20 miles an hour on a clear course, it cannot be utilized in cities of any size to-day. This is due to the fact that the greater number of horse vehicles traveling on the city streets "set the pace," as it were, for the full volume of traffic. Consequently the speed of the more swift mechanical vehicles is kept down. The effect of this is pointed out in the report where the advantage or disadvantage of working an electric vehicle to its maximum mileage capacity per day is considered, and it will be noticed that it is a very strong retarding influence—a mass possessed of enormous inertia—against which the advancing wave of mechanical locomotion on common roads must dash with much vigor before it can be washed away, and the full advantages claimed for commercial mechanical vehicles of any type can be realized.

Having come thus far on our way, we leave this Fliess report as a mile-stone from which to measure the further progress in the electric vehicle industry. Taken as a whole, the report, we believe, will be found of more value the more it is studied; and to those who are at all interested in having exact knowledge as to just what may be expected of electric vehicles to-day, and who wish to form an accurate idea as to the possibilities of the future, it will, we are sure, prove of much assistance.

ELECTRIC EFFECTS OF ULTRA-VIOLET LIGHT.

It was noticed by Hertz and others in experimenting with spark gaps that when the sparking electrodes were illumined by ultra-violet light, the electric discharge occurred more readily, so that either the sparking distance could be increased for a constant difference of potential or the sparking difference of potential might be reduced for a given striking distance. A number of researches have been conducted in the direction of elucidating this remarkable phenomenon. Ultra-violet light is merely another name for light that is invisible to the eye on account of its being beyond the violet end of the visible spectrum, and which has therefore a greater frequency and smaller wave-length than eye-perceived light. It seems that such light, when shining upon the spark gap produces ions or electrical particles. It was supposed at first that this was due to the splitting up of molecules into atoms, which atoms were inherently electrified bodies. More recently, however, reasons have arisen for supposing that the ions are sub-atomic masses, or that an atom, which has no free charge, may be split up into corpuscles which are inherently electrified with opposite signs. But whether the ions are atomic or sub-atomic masses does not affect the main questions concerning the action of ultra-violet light.

It is understood that a perfect vacuum, or simple ether, cannot convey an electric charge conductively. It can only transmit electric action inductively. Similarly it is understood that a gas like air cannot conduct electricity so long as there are no ions present; or, according to the theory, as long as all the matter existing in the air is in the molecular condition with either no loose electrified atoms or no loose electrified sub-atoms to convey the electricity. It is further supposed that there are always a few straggling ions present in the air, or minute electrified particles in the unattached state, but that they are ordinarily so few in number as to make air the good insulator we know it to be. On the other hand, there is good reason for believing that aqueous solutions of salts, such as copper sulphate, for example, contain numerous free ions in the ordinary condition, and, therefore, these solutions are initially fairly good conductors. Under the electrostatic force acting between the charged electrodes of a spark gap, such ions as already exist are driven across the gap, just as though they were electrified pith balls, and, colliding against neighboring gaseous molecules or atoms, split these up into the ionic or dissociated condition, thereby producing more ions, until the number of ions becomes sufficiently great to conduct the electricity in the form of a spark discharge. Ordinary light, although it is supposed to execute about 500 millions of millions of double oscillations per second, is supposed to be too slow and to have a wave length too long to have much disruptive effect upon the molecules or atoms in its path. In a stream of luminous ether waves the molecules or atoms jostle and oscillate in sympathy like ships on the ocean, but are not ordinarily torn apart thereby. When, however, the wave length is considerably shortened and the frequency increased, as in ultra-violet light, the oscillations become so swift and vigorous as to jostle the atomic or molecular associations into disruption. The disrupted masses are then ions and thus tend to facilitate the electric discharge.

Some recently published experiments of Lenard indicate that when a negatively charged electrode is placed in a vacuum tube exhausted as highly as possible, the impact of ultra-violet light upon the electrode causes it to emit rays that have all the characteristics of cathode rays. In other words, the impact of ultra-violet rays upon a negatively charged electrode in a space that has been exhausted of gas as far as physical means at present permit, causes the electrode to emit rays that are similar to those given off in a Crookes tube under the sole influence of powerful electrification. The ultra-violet rays produce ions either from the superficial layer of matter in the electrode or from gaseous matter occluded in this layer, and these ions are urged forward in straight lines from the electrode with a speed which may be comparable to that of light itself.

Althought the conduction of electricity in electrolytes and in gases is now generally admitted to be due to the presence of ions, it has been generally supposed that its condition in metals is due to some other process. A recent theory, however, offers the suggestion that the conduction of electricity in metals is also due to the motion of ions. In this case, however, the ions are supposed to have but a very limited range of oscillatory motion, and to hand their electric charges from one to another in rapid succession. It has also been recently suggested that the rotation of ions in molecular or atomic orbits with their accompanying electric charges is capable of producing the equivalent of Ampere's molecular magnets and of accounting for the inherent magnetism of iron molecules.

Although some of the above-mentioned hypotheses do not rise above the rank of suggestions at the present time, it is evident that the molecular physics of the next century will be largely devoted to the study and elucidation of the nature and motion of ions.

A Plea for Standardization.

Last week we made comment on the need of some sort of concert of the powers in the matter of frequency. It takes small foresight to realize the good that might come from a more complete and definite step in the direction of standardization in general, or rather the inhibition of innumerable devious and special types. The committee on standardization of the American Institute of Electrical Engineers has done within a somewhat limited field sterling work, but its actual power is small, for it has to depend on the gentlest kind of moral suasion. It needs the active co-operation of the members of the Institute in enforcing its suggestions.

The standardization aimed at is in the sense of a general convention regarding the sizes, speeds and voltages of electrical apparatus which shall be regarded as standard. Its purpose is, first, to diminish the very great and annoying difficulties introduced by unrestrained specialization, to encourage the production of standard electrical machinery at a low price, and to render possible a certain amount of interchangeability.

Very few persons outside of the responsible heads of the large manufacturing companies can realize what a prodigious amount of special machines are yearly built to meet unreasonable and unnecessary conditions at great added cost and at the inconvenience of all parties concerned. What was at first only a commercial inconvenience has come to be a great and crying grievance, one of the evils that has crept insidiously upon and dominated the rest. Save in the smaller sizes, very few duplicate machines are to-day turned out by the electrical manufacturers, and the variations are not by way of improvement, but merely to meet conditions which it would be far cheaper and better to avoid. The fault is about equally divided between purchaser, engineer and salesman. The operation, or rather the course, of the special-design mania, is ordinarily about as follows: John Doe organizes a company to develop a promising hydraulic privilege, and takes counsel with himself as to ways and means. To employ a consulting engineer seems a needless expense, when so many people supply engineering free to users of their goods. So presently appears Richard Roe, agent of some active hydraulic equipment concern, with a large package of blue-prints, and an earnest determination to make a sale. John Doe knows nothing about the electrical requirements, and Richard Roe does not care much so long as he makes a sale. Therefore John Doe contracts for, let us say, three vertical shaft turbines, each of 902 horse-power, at 131 r. p. m. Then the trouble begins, and in the long run three totally new dynamos, special in almost every particular, are ordered after much growling. The total cost of wheels and generators is far in excess of what it should be, and the odium falls on the electrical manufacturer. Or John Doe is building a mill and thinks he will get figures on an electrical drive. So he calls in Richard Roe, engineer and contractor, who is a worthy and most intelligent man with an obsession of direct coupling and low speed. Then the manufacturer is asked to bid on fourteen 12-hp motors at 225 r. p. m., probably polyphase at that. And thus the good work goes on until John Doe has acquired at large expense from unwilling makers a stock of apparatus which is of practically no value anywhere else, of which no spare parts are kept in stock anywhere, and which can be delivered only after long delay due to the need of preparing drawings and patterns. If this sounds like exaggeration, we can only say in some respect or other it is all truth.

The best example of standard practice is found in railway work. Railway motors are undergoing constant improvement, but in voltage, power, speed and general design they have settled into standard lines. Changes are for the sake of improvement, not to meet the imagined requirements of particular roads. The result is that to-day the ordinary standard sizes of railway motors are not only admirable machines in design and construction, but they are per horse-power uniquely cheap. Spare parts can always be had and repairs can be easily made. Now even the railway generators are at least standard in voltage, and in general type, and though the victims of varying engine speeds, to a certain extent, can be adjusted to meet conditions not too widely different. Perhaps generators, motors and transformers for general use can never be standardized as thoroughly as are railway motors, but if about half the special types could be eliminated, the remaining ones could be made in sufficient numbers to secure prompt delivery, low price and quick supply of spare parts. It actually happens now that one may find machines of intrinsically costly design and unfavorable size to be cheaper than others in which all the conditions seem to be favorable, merely because the former happen to have been sold in sufficient numbers to bring the construction down to standard lines. If the purchaser by the exercise of a little foresight can employ apparatus that is both good and cheap, that can be quickly procured and repaired and that has an appreciable market value if he wants to get rid of it, he is assuredly greatly the gainer thereby. The manufacturer on his part is relieved from much unnecessary expense and trouble, and can bring his general expenses down very materially by settling into a systematized manufacture.

If the large makers could establish a sort of *modus vivendi* on the matter of standard sizes, speeds and periodicities, and the engineers would follow definite lines in their specifications, as recommended by the A. I. E. E., the man who foots the bills would in the long run be a great gainer, for uneconomical methods benefit no one, and in the end the saving from their abolition is the joint gain of all concerned, and the advancement of the art.

Annual Meeting of the Automobile Club of America.

The annual meeting of the Automobile Club of America was held at the club rooms in the Waldorf-Astoria on Oct. 22, when there was a very large attendance of the members, while the utmost interest was taken in the proceedings. There were two tickets in the field, one of them "regular" and the other put up by an opposition which represented the sentiments of a large portion of the club. This was shown by the polling, when the opposition ticket went in with a clean sweep, in the proportion of about 3 votes to 1. The whole proceedings were, however, characterized by good feeling and with every evidence on all sides of a common desire to make the club a success as a strong national body directing the art and sport of automobilism in this country. Mr. A. R. Shattuck, the new president, who was on both tickets, has done excellent work, which all present were prompt to recognize and reward. The other officers chosen were: First vice-president, Albert C. Bostwick; second vice-president, J. Dunbar Wright; third vice-president, David Wolfe Bishop; treasurer, Jefferson Seligman; secretary, Malcolm W. Ford; governors (class of 1903), Sydney Dillon Ripley, J. M. Ceballos and Dave H. Morris.

Mr. George F. Chamberlin, who has been acting president of the club for nearly a year, presided. The retiring secretary, Homer W. Hedge, said the club owned its existence to an informal meeting in May, 1899, of Mr. George F. Chamberlin, Whitney Lyon and Winslow E. Bagby. In the following June the club was formed. Now the membership is 262, and club affiliations have been established with the Automobile Clubs of Great Britain and Ireland, France, Belgium, Switzerland, Berlin, Vienna and Turin. In this country associate relations have been established with the clubs lately organized in Philadelphia, Cleveland, Chicago, Buffalo, Rochester, Worcester, Syracuse, Paterson, Baltimore, Westchester County, Bridgeport and San Francisco. Clubs are in process of formation in Boston, Cincinnati and Minneapolis.

The treasurer's report announced a balance of $2,186.97, the total receipts being $7,616.27. The committee on the coming Automobile Show in Madison Square Garden, Nov. 3-11, made the report that $18,204 had been received from exhibitors, and this, with the minor receipts, gives the club $19,916 in hand, with the opening day nearly two weeks off, a big financial success being thus assured, there being a good margin over the rent of the garden.

The membership made a gain during the year of about 150. There were reported 210 active and 34 associate, with 16 enrolled since the annual report was made up. The interesting fact came out that 166 of the members were owners of automobiles, and that every one of these were "chauffeurs" in their own right. The number of such members in the club is rapidly growing. Reports of an excellent nature were made by Messrs. Shattuck on the automobile show, good roads and the library; Chamberlin, from the legal committee; Bostwick, from the runs and tours committee; Field, from the technical com mittee, and Lyon, from the house committee. Good work and abundant sociability were indicated in every direction.

President Shattuck, in a brief inaugural, laid stress on the importance of trials and contests, but distinguished as highly preferable those on the highway, there being little or no utility in those on a mere racing track. The question of new club quarters was referred to the new board of governors and will be taken up at once.

Electrical Men in the Sound Money Parade.

Preliminary steps having been taken last week to create a separate electrical division of the great Sound Money Parade, which is to take place in New York City on Nov. 3, another enthusiastic meeting of the committee of initiative was held at Room 20, 39 Cortlandt Street, on Oct. 22, when it was voted to name the division the Electrical Industries Association of the Sound Money Parade. Regular organization was effected as follows: President, E. S. Keefer; vice-president, Allan S. Bakewell; secretary, H. B. Kirkland; treasurer, G. L. Patterson; marshal, H. L. Shippy. These form the executive committee, with Dr. S. S. Wheeler, John H. Dale and T. C. Martin. A finance committee was appointed, composed of the treasurer, Dr. Wheeler and J. W. Godfrey. A committee on badges, flags, canes and general equipment was formed, comprising H. F. Albright, C. S. Pease and J. W. Dale. Secretary Kirkland was appointed a committee of one on music, and Mr. Martin a committee of one on press. From the reports already filed it is evident that not less than 3000 marchers may be counted on from the electrical industries, and at the rate applications for a place in line are rolling in, the number may easily run up to 4000 and even 5000. The total of the parade is already 125,000. In the electrical division the Western Electric men will turn out 1500 strong under Mr. Albright, president of their association. The Crocker-Wheeler contingent will be upwards of 500; the Sprague Electric body Mr. Bakewell estimates already at over 400. These will all have bands of their own, as will the Safety Cable contingent. The Electrical Association has already contracted for the services of three fine bands also, so that there can be no doubt that at least the electrical division will step to music. Large electrical manufacturing concerns, supply houses, contractors, etc., are all enrolling, and applications for a place should be filed immediately with Mr. Kirkland at Room 20, 39 Cortlandt Street, where work is already being pushed most actively. Among those who have participated in the recent meetings for organization are those above named and many others, including Messrs. Beran, Albright, Littlefield, Williams, Hall, Eckert, Blackall and Rice. The officers not only invite personal participation in the work, but solicit subscriptions. This is the first time that the electrical industries have "lined up" as such before the New York public, and there is the keenest desire everywhere in the local trade that an impressive front shall be shown. Marshal Shippy is already busy with the many important details of organizing his forces and arranging for place in the parade, time of starting, etc. Other meetings will be held during the present week, and practically daily up to the date fixed.

It will be remembered that in the Sound Money Parade of 1896 the electrical contingent was split up, most of it being in the metals and machinery division. The political season is a busy one with electrical people, and this tends to keep down the number of marchers. The New York Telephone Company, for example, has 800 special election telephones to put in.

Important Decision as to Trolley Fares.

The Wisconsin Supreme Court has handed down a decision that will be hailed with satisfaction by street railway companies all over the country. It was the last step in the suit brought by the Linden Land Company against the Milwaukee Electric Railway & Light Company, the decision of the lower court being reversed with directions to vacate the preliminary injunction. The fact that the Common Council extended franchises which had not expired, the court says, would not make the ordinance void, as the Council had that power. Of the objections concerning alleged irregularity of procedure in passing the ordinance, the court says they cannot be raised by private parties, but only by the State.

Taking up the question as to whether the suit is a proper taxpayers' action the court finds it is not. "It seems very plain to us," says the court after referring to the offer of $100,000 to the city for the franchise, which was refused, "that this action of the Common Council cannot be called in any proper or reasonable sense a squandering of public funds or property. The question before the Council was," says the court, continuing, "what terms should be attached to the grant, whether it was more beneficial to the public to secure a cash payment which would benefit taxpayers only or to secure lower rates of fares for the public generally, or to impose other conditions, and after exercising its discretion in favor of a general reduction of fare it cannot be said that any city fund has been squandered, lost or misused."

"Whether the city," continues the court, "should receive any fund was a question for the Common Council in its discretion to decide. When it decided that there should be no fund, but that reduced fares or other limitations upon the grant were more desirable for the public, it may or may not have exercised good discretion, but it has dissipated no city fund or property."

Concerning the contention that the granting of the franchise would put property to great expense in repairing, widening and improving streets and from electrolysis, the court says that the fact of injurious effects resulting from the granting of a franchise does not impair the power to grant it, it being simply a question of discretion wholly within the province of the Common Council, not to be controlled by taxpayers.

This decision ends the efforts made to prevent the passage of a long-time ordinance giving the street car company the right to charge a five-cent cash fare until 1935. The company now has exclusive control of the street railway traffic of the city until 1935, with a firmly fixed rate of fare for that period. It can now afford to make extensions and improvements, and will spend $10,000,000.

The Electric Automobile from a Commercial Point of View—III.

The Present Commercial Status of the Electric Automobile for Light Delivery Service.

(*Concluded.*)

By Robert A. Fliess, E. E.

SOMETHING over 3000 years have elapsed since the horse first entered as a factor into the commercial life of the world. In this time ample opportunity has been afforded to discover the peculiarities and limitations of the "noble animal," and commercial requirements have been so molded that they now adapt themselves harmoniously to the exact conditions which are inseparable from horse service and which have become so familiar that they are often forgotten or overlooked.

Not so with the electric vehicle. It is now but a little over three years since the first electric automobiles built for regular commercial purposes were put in operation. Though a number of vehicles have been in commercial service during this period, it has been impossible to become familiar with all the ways, peculiarities and limitations inherent in them. Consequently they have, in many cases, been grossly misused, and as a natural result have been unable to do themselves full justice, and often no proper credit at all.

When the limitations of the electric vehicle are more generally understood, when its ways and peculiarities have been more thoroughly mastered, and when commercial requirements are adjusted to suit these, then will the electric vehicle take its place in the commercial life of the world—a place for which it is admirably suited, and in which there is a large field of usefulness open to it.

The electric vehicle is essentially a machine and must be treated as such. It needs attention—skilled attention. Not as much as the horse, perhaps, with which it is competing for public favor, but nevertheless it requires constant and proper care under competent supervision. This is especially true when the vehicle is expected to give efficient and regular commercial service for a reasonable length of time.

That when properly handled and cared for the electric vehicle may be expected to accomplish successfully the work required of horses and wagons in light delivery service in the Borough of Manhattan under ordinary commercial conditions, it is thought the results presented in Parts I and II of this investigation show clearly. That the conditions imposed on vehicles engaged in this class of service are well suited to it has been shown. The average distance which these vehicles are called upon to travel per trip is well within its commercial radius of action on one charge of its battery. The "loads" which must be carried in this class of service can be easily handled by it and at a higher average rate of speed than that which can be maintained by horses under similar conditions. Hence, the development of the electric automobile, from a mechanical point of view, would seem to have reached the stage where electric vehicles can be expected to perform the work required of horses in light delivery service, always provided that the electric vehicles receive the constant and skilled attention which they require.

THE COST.

Having decided that the electric automobile can do the work required of horses and wagons engaged in light delivery service in the Borough of Manhattan, from a mechanical point of view, it becomes of interest to inquire into the relative economy of the two systems for the accomplishment of the same work.

As stated in Part II, the figures there given as to cost of operation, maintenance, etc., for a unit to the stable selected for comparative purposes are practically the lowest that could be obtained in the city. Therefore the results of any comparison made with them, it is thought, may be taken as conservative; and—always provided that proper allowance is made for the excessive depreciation which at present takes place in the electric system—may even be considered as favoring the horse.

Table XIV. Part II.* includes all items which enter into the total cost of keeping a horse delivery unit in the Borough of Manhattan which were not considered common to the two systems. From this table it was found that it costs the stable represented $4.709 per day to operate one of its delivery units; and, assuming the "load" carried on leaving the store to be 600 pounds, the average distance traveled per day per wagon to be 33 miles—16.5 miles averaged per day per horse—that the cost per ton-mile is 15.02c., the cost per car-mile 14.27c., the cost per pound of delivery .04756c., the cost per pound of total delivery per day—three deliveries a day of 600 pounds each on leaving the store—as .26161c.

The cost for the same service when an electric vehicle is substituted for the horse unit will now be considered. To make the comparison as representative as possible, one of the vehicles, tests on which are recorded in Part I, has been selected for substitution. The one which most closely corresponds to the style of horse vehicle now maintained by the stable with which the comparison is to be made is vehicle A.

The weight of vehicle A, as given in Table I, †Part I, is 3085 pounds. The average weight of the driver and his helper, as noted in Part II, may be taken as 150 pounds for the driver and 125 pounds for his helper. The average load carried throughout the trip may be taken as 300 pounds—600 pounds on starting from the store, as noted above. Then the weight of vehicle A, with the operator, his helper and the average load carried throughout the trip, becomes 3660 pounds.

It was shown in Part I that the average rate of power consumption for well-designed electric vehicles under ordinary service conditions in the Borough of Manhattan may seldom be expected to exceed 115 watt-hours per ton-mile, and is often less. Therefore, assuming 115 watt-hours per ton-mile to be the average rate of power consumption required in ordinary commercial service the year round in the Borough of Manhattan for vehicle A, the cost of current per ton-mile actually needed to propel it, is .575c. when current is paid for at the rate of 5c. per kilowatt-hour. This, however, is not the total amount for current that must be paid per ton-mile, as the loss which occurs in the storage battery must be considered.

As pointed out in Part I, the average efficiency of storage batteries employed in electric vehicles should not often show less than 70 per cent when used under proper conditions and when given the attention which they require. Therefore, the average efficiency of the battery in vehicle A will be taken as 70 per cent. The average number of watt-hours that must be paid for per ton-mile becomes then 164.29. Hence, the average cost for current required to propel the vehicle per ton-mile is .82145c.

The total weight averaged throughout a trip was found above to be 1.83 tons. Therefore, the average number of watt-hours required to propel the vehicle per mile is 300.65, and consequently the average cost for the current required to propel the vehicle per mile is 1.5032c. This, for an average distance of 33 miles a day per wagon, makes the cost for current per day 49.605c. for an electric unit when current is paid for at 5c. a kilowatt-hour, as against 66c. a day for the food and bedding needed by the two horses which are used to cover the same distance per day—practically a saving of 25 per cent in favor of the automobile.

When the interest, depreciation and repair items for the two systems are considered, however, the automobile at present does not make such a favorable showing. That this is not an unnatural condition at this stage in the development of the automobile, the early commercial history of most of the other great revolutionizing industries in the electrical field that have been developed and matured within the present century bear witness; and when one looks into the future, illumined by the light of experience, it would seem to be an abnormal condition which will shortly pass away. However, at the moment our interest centres on the conditions which exist at present, and when a just comparison is attempted these items must be considered at their full value.

*Vol. XXXVI., No. 16, p. 605.

†Vol. XXXVI., No. 16, p. 603.

DEPRECIATION AND REPAIRS.

The present state of the automobile industry does not afford much opportunity for an extended consideration of the factors which enter into the calculation of depreciation and repair costs for electric vehicles in commercial use, as hardly three years have elapsed since their first practical introduction. Consequently some of the points that must be considered have as yet not been fully tested. Hence, the results obtained to-day will probably be altered as advancing time permits more accurate data to be collected. The figures used in calculating the following table, however, are the result of much inquiry among the various men who have had the most experience with electric vehicles in commercial use up to the present time, and, it is thought, they represent fairly the conditions which actually exist.

The two parts of electric vehicles which are now giving the most trouble are the rubber tires and the storage batteries. Rubber is very costly at present, and rubber tires soon wear out, making a frequent renewal necessary; and consequently the cost per mile for tires is very high. The storage battery is a very variable factor. If properly handled it gives very good results, but, like a horse, if maltreated, its useful life is greatly shortened. As is well known, one man can drive a horse and get excellent service out of him for many years, while another man may take the same horse and incapacitate him for future usefulness in a short time. It is the same with a storage battery. If properly used and cared for it gives good service for a comparatively long period, while, on the other hand, if improperly treated it may become a hopeless wreck in a few days, and, as it is very expensive, the cost per mile chargeable to batteries may become very great. If properly handled, however, the cost for renewals, repairs, etc., given in Table I need not be exceeded, and, under very favorable conditions, might not be reached.

The results given in Table I are calculated from data obtained by the writer from the most reliable sources of information at his disposal. The table represents the calculated cost per day to the stable noted above for an electric delivery unit on the supposition that all the wagons in the stable have been replaced by electric vehicles and that these are to do exactly the same amount of work as was required of the horses and wagons which they are supposed to have replaced.

TABLE I.

Cost per day for one electric unit in a stable maintaining 20 electric vehicles under the same working conditions as are required of the 40 horses and 20 wagons represented in Table XIV, Part II:*

	Cents.
Interest on first cost of vehicle at 6 per cent per annum	29.58
Depreciation on vehicle—not including batteries, tires or pinions	51.23
Repairs to body motors, running, gear, etc	12.81
Attendance on one vehicle	15.67
Stable rent chargeable to one vehicle	10.27
Insurance on stable chargeable to one vehicle	0.30
Cost of current at 5 cents a kilowatt-hour	41.44
Repairs to battery and depreciation	54.79
Renewal of pinions	4.38
Acid, lubricating oil, etc	7.12
Depreciation and repairs on tires (solid rubber)	31.56
Salary of operator	170.95
Salary of boy	56.98
Cost per day for a unit	487.08

From Table I the cost per car-mile—for an average distance of 33 miles a day—is 14.76c., the cost per ton-mile 8.0655c., the cost per pound of delivery per mile .0492c., the cost per pound of total delivery per day .2706c.

These results—with the exception of the cost per ton-mile—are just 3.33 per cent higher than those found for the horse system working under the same conditions. As this difference amounts to something less than $60 a year per unit, the results may be considered for all practical purposes identical. In fact, if it is assumed that current is bought at the rate of 3c. per kilowatt-hour—as it can be when consumed in large enough quantities—the results given above are changed as follows: The cost per car mile becomes 14.2578c., the cost per ton-mile 7.7911c., the cost per pound of delivery per mile .04752c., the cost per pound of total delivery per mile .2614c., showing a saving in favor of the automobile of almost 1 per cent.

Hence, from what has been said and from the figures given, it would seem as though an electric vehicle—such as vehicle A—operating in the Borough of Manhattan, when properly handled and when given proper care, can be substituted for a horse vehicle used in light delivery service with approximately the same cost for the same work.

A comparison of the interest, depreciation and repair items with the operating expenses and fixed charges shows that the per cent of operating expenses in the case of the horse system is practically equal to the per cent of interest, depreciation and repair charges for the automobile, while, vice versa, the operating charges for the automobile are about equal to the interest, depreciation and repair charges of the horse system. These results can be seen in Table II.

From the table it will be noticed that the per cent of fixed charges representing the cost per day per unit for operator and helper are practically the same for the electric and horse systems when current is bought at 3c. a kilowatt-hour. The per cent of operating costs

TABLE II.

ITEMS.	For the electric system when current costs 5c. a kw-hr.		For the electric system when current costs 3c. a kw-hr.		For the horse system when the units do the same amount of work.	
	Cost per day.	% of total cost per day.	Cost per day.	% of total cost per day.	Cost per day.	% of total cost per day.
Interest, depreciation and repairs	$1.8435	37.84	$1.8435	39.18	$0.6691	14.21
Operating costs	0.7480	15.36	0.5823	12.38	1.7601	37.38
Fixed charges	2.2793	46.80	2.2793	48.44	2.2793	48.41
Totals	$4.8708	100.00	$4.7051	100.00	$4.7085	100.00

differs in favor of the automobile just 25 per cent in this case, however, while the interest, depreciation and repair items show a saving in favor of the horse system of 24.97 per cent.

In considering these figures it should be remembered that the operating expenses of the horse system are practically fixed and that they can only be reduced, under the most favorable conditions, 1 or 2 per cent; while, on the other hand, the operating expenses of the electric vehicle will be reduced much more than this as it becomes possible to buy current at lower rates. The production of current at less than ½c. per kilowatt-hour was but recently noted in the ELECTRICAL WORLD AND ENGINEER, in a not particularly large plant. The economical possibilities of the electric vehicle are more forcibly brought out when interest, depreciation and repair charges are considered. These items for the horse system are practically fixed and little change can ever be made in them. When the improvements which seem almost sure to follow as a result of the enormous amount of talent and energy at present being concentrated on the development of the electric vehicles are forthcoming, and when the pavements of the second city in the world—and other large American cities—have reached that state of perfection which even now can be boasted of by many cities much lower down in the list so far as population and wealth are concerned, these conditions will be changed, and there will then be no question as to the relative economical advantages of the electric over the horse system for the same amount of work in the Borough of Manhattan in light delivery service.

A COMPARISON FOR MAXIMUM MILEAGE CAPACITY.

So far, the comparisons made have dealt with the case where an electric vehicle is required to do the same amount of work as that now required of horse units in light delivery service. That with proper handling and care and when the necessary arrangements have been made for the quick changing of batteries, an electric vehicle has a much greater average mileage capacity per day than the horse unit is evident. In fact, with two sets of batteries, it is possible for an electric vehicle averaging 8.5 miles an hour while in motion to travel 75 or 80 miles a day over the streets of the city.

The case will now be considered where an electric vehicle is used to its maximum average mileage capacity per day under the ordinary traffic conditions which exist at present.

For this case it is necessary to make the supposition that suitable arrangements have been made by which the batteries may be quickly changed, so that when a vehicle comes in from a trip all that is necessary before it is ready to go out again on another is to exchange its discharged battery for a fully charged one. Given the proper arrangements, this can be done very comfortably in less than five minutes.

In Part II it was pointed out that the factors which determine the number and size of horse units engaged in the light delivery service of a store are its volume of business, the number of packages that can be delivered an hour, and the number of hours per day that it has been found practicable to keep a unit in operation with a satisfactory degree of efficiency. These factors must be taken into consideration when determining the maximum average mileage capacity that an electric vehicle can be expected to keep up in light delivery service at present.

The number of deliveries averaged per hour by a horse unit of the store under consideration from the time it leaves its stable until it returns to it again in the Borough of Manhattan was shown in Table IX, Part II,* for an average of 82 readings, to be less than 13 packages an hour, with one delivery boy working on the route. As

*Vol. XXXVI., No. 16, p. 605.

*Vol. XXXVI., No. 16, p. 603.

the electric vehicle is able to keep up a higher average rate of speed than the horse vehicle while in motion, the average rate of delivery per hour may be taken somewhat higher than the figures given above. The maximum rate of delivery noted in Table VI, Part II,* was 26 packages an hour. Taking 24 packages per hour as the average number that can be distributed by an electric delivery unit which averages 8.5 miles per hour while in motion, with one delivery boy working on the route, then, with two delivery boys working on the route, the average number of deliveries possible per hour should be at least 44. The average weight per package as found for this store in Table IV, Part II,** is approximately 4 pounds. Hence, under the above supposition an average of 150 deliveries can be made per trip.

The time the vehicle would average out of its stable on the above supposition per trip is 3 hrs. 25 mins., as against 4 hrs. 30 mins. found to be the average time that a horse is out of this stable, as shown in Table IX, Part II.†

Assuming that the electric vehicle is at rest but one-half the time it is out of its stable, it will be in motion per trip 1 hr. 42 mins. Hence, on each trip it can cover 14.5 miles. Allowing 5 minutes for changing batteries, the time occupied on each trip will be 3 hrs. 30 mins. The average of 31 readings as shown in Table IX, Part II,† for the stable now being considered, gives 10 hrs. 35 mins. as the average time its vehicles are out of the stable per day. This is quite long enough to require an operator and delivery boy to work per day. The average distance that can be covered per day, then, is practically 43.5 miles, which is probably as high an average as it is possible to keep up in a 10.5-hour working day with an electric delivery unit under the restraining influence of the average speed now maintained by traffic in general in the Borough of Manhattan. This is at an average rate for the electric vehicle from the time it leaves its stable in the morning until it returns to it again for the night, of over 4 miles per hour, as against 2.74 miles per hour shown in Table IX, Part II,† to be the average speed now sustained by horse vehicles under similar conditions.

The electric vehicle, under the above supposition, can make three trips a day of an average length of 14.5 mile a trip in 10.5 hours, delivering on each trip 150 packages, or 450 a day. This makes the total weight of delivery per day 1800 pounds—averaging 300 pounds of load carried on each trip. The cost of this service per unit will, of course, be greater than that already given for an electric unit per day.

The weight of vehicle A, which is again taken as the type of vehicle employed, is, as before, 3085 pounds. The weight of the operator is taken, as before, at 150 pounds. In this case two delivery boys are carried. Their combined weight may be taken as 250 pounds, and the weight of the average load as 300 pounds per trip. Then the average weight of the unit is 3785 pounds, or 1.8925 tons. When current is bought at the rate of 5c per kilowatt hour, the cost per mile for current is 1.5546c., as against 1.5032c. for the first case considered. As under this new supposition a greater distance by over 24 per cent is required of each vehicle per day, the rate of depreciation, cost of repairs, etc., noted in Table I of this part will be exceeded, and must, therefore, be changed to fit the new requirements. The cost per day due to an extra delivery boy and an extra battery must also be considered. In Table III the cost per day for a unit under the above supposition is given.

TABLE III.

Cost per day for one electric unit in a stable maintaining 15 electric vehicles, which are required to cover the same ground per day as is required of the 40 horses and 20 wagons represented in Table XIV, Part II:‡

	Cents.
Interest on first cost of vehicle at 6 per cent per annum	29.58
Depreciation on vehicle—not including batteries, tires or pinions	56.71
Repairs to body, motors, running gear, etc	14.18
Attendance on one vehicle	15.67
Stable rent chargeable to one vehicle	10.27
Insurance on stable chargeable to one vehicle	0.30
Cost of current at 5 cents per kilowatt-hour	56.61
Repairs to battery and depreciation	54.79
Repairs to extra battery and depreciation	54.79
Renewal of pinions	5.48
Acid, lubricating oil, etc	8.90
Depreciation and repairs on tires (solid rubber)	35.07
Interest on extra battery at 6 per cent per annum	5.79
Salary of operator	170.95
Salary of two boys	113.96
Cost per day for a unit	632.95

From Table III the cost per car-mile—for an average distance of 43.5 miles per day—is 14.55c., the cost per ton-mile 7.688c., the cost per pound of delivery per mile .0485c. These figures are practically identical with those already given for the case where the electric unit averages 33 miles per day. It should be remembered in this connection that the figures given for the case considered in Table III include the extra cost chargeable to an extra delivery boy, an extra battery and the increased depreciation and repair items. Yet with all these extra charges, amounting to over $1.45 more a day per unit, the cost per ton-mile per car-mile and per pound of delivery per mile remains practically the same.

It is when considered in this connection that the great advantage to be derived in the future from mechanical transportation on common roads is shown. As will be noticed, though the actual ratio of the costs per unit per mile for the same weight of "paying load" remains practically the same for the two systems, the electric unit can actually cover per day a distance which it would require over 1.33 horse units—averaging 33 miles a day—to cover. In other words, 15 electric units, if worked at the maximum mileage capacity which it seems would be possible to obtain with them at present under ordinary service conditions in the Borough of Manhattan, can cover the same ground which 20 horse units are covering with practically the same cost per pound of "paying load" per mile.

At present, however, when the total "load" that is carried per day under the supposition just considered is taken into account, the method of working electric vehicles in light delivery service in the Borough of Manhattan to their maximum average mileage capacity per day would seem to be less advantageous than using the vehicles under exactly the same conditions as are now imposed on horse service of this class. For, when the conditions upon which the 43.5-mile-a-day supposition was based are considered, it would seem that but an average of 150 deliveries a trip are possible under it, and as only three trips a day of the average length can possibly be made under present limitations, the cost per pound of total delivery becomes .3516c., as against .2706c. for an electric unit working under the normal conditions which exist at present, thus, it would seem, indicating that the time has not yet arrived for using electric delivery units to their maximum mileage capacity per day in this service.

When the average speed of traffic on the streets of the Borough of Manhattan has been raised sufficiently, however, as it surely will be in the future by the improvements that will be made in the paving and by the substitution of mechanical traction for the public and private horse systems now operating within its boundaries, and by the elaborate system of rapid transit now under construction, as well as by the several bridges now being constructed, then the economy of working electric vehicles to their maximum mileage capacity per day for light delivery service may be taken advantage of.

COMPARISON FOR A SPECIFIC CASE.

So far, the comparisons that have been made have all been based on the supposition put forward in Part II that the average load on leaving the store is 600 pounds, and that the average distance covered per day by a wagon is 33 miles. As was noted when this supposition was made, it is thought that it is very conservative, and perhaps favors the horse. To illustrate this, another case was considered in which the figures used were the actual results obtained from the tables in Part II. As remarked then, these results probably represent very closely the true conditions which exist at the moment in the stable that has been used as a standard. Therefore, it may be of interest to notice how these figures compare with those obtained when considering the cost of operating and maintaining an electric vehicle under the same conditions.

From Table VIII, Part II,† the average distance traveled per day per wagon for this stable was found to be 28.21 miles. From Table IV, Part II, the average load on leaving the store was taken to be 300 pounds. The cost per car-mile under this supposition for the horse system was found to be 16.692c., the cost per ton-mile 19.354c., the cost per pound of delivery per mile .11128c.—average load throughout trip 150 pounds; the cost per pound of total delivery—900 pounds per day—as .5232c.

For this case the weight of vehicle A, with operator, boy and average load, becomes 3510 pounds per trip, or 1.755 tons. Hence, the cost of current at 5c. per kilowatt-hour is 1.4416c. per car-miles, as against 1.5032c. under the 33-mile-a-day supposition.

The total cost per car-mile for current is found to be 1.7238c., the cost per ton-mile 9.8227c., the cost per pound of delivery per mile .11492c., the cost per pound of total delivery .54034c. A comparison of these figures with those for horse service under the same conditions as given above shows that the cost per car-mile is 2.116c. cheaper for the electric

*Vol. XXXVI., No. 16, p. 602. **Vol. XXXVI., No. 16, p. 600.
‡Vol. XXXVI., No. 16, p. 605.

†Vol. XXXVI., No. 16, p. 603.

service, and that the cost per ton-mile is 5.87c. cheaper. But, on the other hand, it will be noticed the cost per pound of delivery per mile is .00364c. more expensive for the electric than for the horse system, and also that the cost per pound of total delivery is .0171c. more expensive. This is .0019c. more per pound of delivery for the electric system than is shown for it under the 33-mile-a-day supposition, and .0081c. more than per pound of total delivery.

In this connection it may be noted that the per cent of average "paying load" to the total weight of the unit under the 33-mile-a-day supposition is 8.92 per cent, as again 4.27 per cent for the 28.21 miles a day supposition, which accounts for the increased cost per pound of delivery per mile and per pound of total delivery per day, and points out again that which has already been noted in Part I, namely, that there is a great advantage, from a commercial point of view, in using as light an electric vehicle as safety and durability will permit.

The per cent of "paying load" to the total weight of the unit for the horse system under the 33-mile-a-day supposition, is 9.75 per cent, as against 5.12 per cent for the 28.21 miles a day supposition when taking the average weight of a horse used in light delivery service as 1200 pounds. This shows a saving in dead weight in favor of the horse system of less than 1 per cent, which is not as great a difference as seems generally to be assumed.

SUMMARY.

In Table IV, the various costs per car-mile, ton-mile, etc., that have been noted under the several suppositions which have been made are collected. The table offers a convenient means of quick comparison.

TABLE IV.

ITEMS.	For the electric system when current costs 5c. a kw-hr. for the 33 miles a day supposition.	For the electric system when current costs 3c. a kw-hr. for the 33 miles a day supposition.	For the horse system for the 33 miles a day supposition.
	Cents.	Cents.	Cents.
Cost per car-mile...	14.7600	14.2578	14.2700
Cost per ton-mile...	8.0655	7.7911	15.0200
Cost per lb. of delivery per mile..	0.0492	0.0475	0.0475
Cost per lb. of total delivery per day	0.2706	0.2614	0.2616
	For the 28.21 miles a day supposition.	For the 28.21 miles a day supposition.	For the 28.21 miles a day supposition.
	Cents.	Cents.	Cents.
Cost per car-mile...	17.2389	16.6580	19.3540
Cost per ton-mile...	9.8227	9.4930	16.6920
Cost per lb. of delivery per mile..	0.1149	0.1110	0.1112
Cost per lb. of total delivery per day	0.5403	0.5221	0.5232
	For the 43.5 miles a day supposition.	For the 43.5 miles a day supposition.	For the 43.5 miles a day supposition.
	Cents.	Cents.	Cents.
Cost per car-mile...	14.5512	14.0317	.....
Cost per ton-mile...	7.6888	7.4140	.....
Cost per lb. of delivery per mile..	0.0485	0.0467	.....
Cost per lb. of total delivery per day	0.3516	0.3391	.....

The figures given in Table IV, it must be remembered, do not represent absolutely the total cost for the service indicated, for, as has been noted, the items common to the two systems have not been considered. It is thought, however, that the table indicates the present relative commercial value of the two systems under the several suppositions made, always providing that each electric unit receives the proper and skilled handling and attention which it requires.

It may be well to call attention again to a point that has been noted several times before, namely, that the stable against which the comparisons are made is run on a much more economical basis than those connected with most of the department stores of approximately the same size.

CONCLUSION.

Though the writer does not intend to discuss at length the advantages and disadvantages of electric vehicles for the several other classes of commercial service in which they are now being used, it is thought that it may not be uninteresting if a brief indication of the present commercial position of electric cabs, etc., for public service in the Borough of Manhattan is given in the light of the data that has been presented.

When it is remembered that the cost per car-mile noted in Table IV under the 43.5-mile-a-day supposition is less than 15c., and that this represents within a few per cent the total cost per mile to operate and maintain an electric delivery wagon which weighs empty a little over 3000 pounds, and which it has been assumed is carrying for a distance of 43.5 miles a day an average "load" equivalent to that which would be caused by five persons averaging 140 pounds apiece, the commercial possibilities of electric automobiles for use in the Borough of Manhattan as public cabs are indicated. It may be pointed out in this connection that as the present legal charge in the city is 50c. a mile for public cabs, that any company that can keep the expense chargeable to one of its units under 50c. a mile should at least not lose money; and from the figures already given it would seem as though if the cabs are well patronized, those financially interested might well look for substantial returns.

When the electric vehicle is used for private livery service, the cost becomes of secondary importance, and for this class of service it would seem to be decidedly the ideal vehicle. It has a mileage capacity on one charge of battery which, with a little forethought, is at present easily sufficient to satisfy the ordinary demands on this class of service in the Borough of Manhattan; and as the demand increases, the facilities for charging a battery en route will constantly multiply, so that in time it will undoubtedly become possible for vehicles to charge during the time their owners are in shops making purchases, or are occupied in making calls, thus increasing the possible mileage capacity of a private vehicle quite beyond that which ordinary requirements will ever need.

That at the moment the electric automobile is distinctly a vehicle for use on good roads and where the necessary charging facilities are at hand, it is thought, is generally recognized. Also that its specific field of usefulness from a commercial point of view is at present in cities and towns.

That the electric automobile, even at this very early stage in its commercial development, gives unmistakable evidence of the great place which it is destined to fill in the future commercial life of the cities and towns of the world, it is thought the data and results that have been presented in this paper show conclusively. That even at the moment it has reached a stage in its development where it can be successfully substituted for horses and wagons engaged in certain classes of service, the results obtained indicate, and that with proper care and attention, efficient service may be expected of it under the average weather conditions which are likely to be encountered in the Borough of Manhattan during the year, would seem to have been demonstrated.

Electric Rapid Firing Guns.

In a recent issue of this journal, note was made of a novel electrical gun devised by an engineer in England. In this quick firer the motive power is electricity, and it is stated that the gun can fire 18,000 rounds at the rate of 3000 a minute. The gun apparently has the motor applied on one side by means of gearing to the rotary disk which ejects the shots from the barrel. It now appears a practically identical invention was patented in Germany over four years ago by Gen. Eugene Griffin, U. S. V., vice-president of the General Electric Company. We have a copy of his German patent before us, and note that in it preference is given to mounting the motor on a vertical shaft without gearing and using a very high speed motor. This would appear to be a decided gain and advantage, and it is questionable whether continuously satisfactory results could be obtained with the geared motor. Fundamentally it would seem that the English gun differs in no respect from that which was invented by Gen. Griffin so many years ago, and for which broad claims were granted. In his patent Gen. Griffin points out that the gun could be made not only a portable field piece, but that if employed in a permanent fort or on a ship, several could be fed from one central generating plant. As Gen. Griffin points out, also, the advantage of such a gun is that it operates without noise, smoke or the appearance of fire, and it is not annoying because of fumes, etc., to the men in charge. It has few, if any, elements of danger, and can be easily concealed from the enemy. Furthermore, from revolving several barrels, it should be much more durable and longer useful than the ordinary gun, the barrels of which, as is well known, become useless after the discharge of a small number of shots. Gen. Griffin also remarks that such a gun should be found very useful in operating fireworks, the throwing of fire-balls, in the life-saving service and in the signal service. The apparatus of the Griffin patent is spoken of as the "flying power fire machine" in the German patent referred to.

Swiss Dynamo-Electric Machinery at the Paris Exposition.

It must be admitted that one of the best exhibits of dynamo electric machinery at the Paris Exposition is that from Switzerland, a country which has long been one of the most progressive electrical centres of Europe, and which now shows no intention of giving up any portion of its leadership. A conspicuous part of the Swiss exhibit that does so much credit to its origin is furnished by Brown, Boveri & Co., of Baden. It is unfortunate, indeed, that the exhibit should be so widely scattered, like many others, preventing the visitor from getting any kind of collective idea, except at the expenditure of a serious amount of time and effort. The main exhibit seen as one enters Electricity Building from Transportation and Chemistry Building is such, however, as to arrest the attention of every lover of fine machinery, skillfully designed and artistically built. The main item here is the machine shown in the perspective and diagramatically in Figs. 1, 2 and 3. It is a beautiful three-phase 1500-kw generator giving 6000 volts at 42.6 cycles per second. The armature is carried by two spider frames, with trunnion rings cast on the bearings, a concentric position of the armature with respect to the field magnets being thus assured.

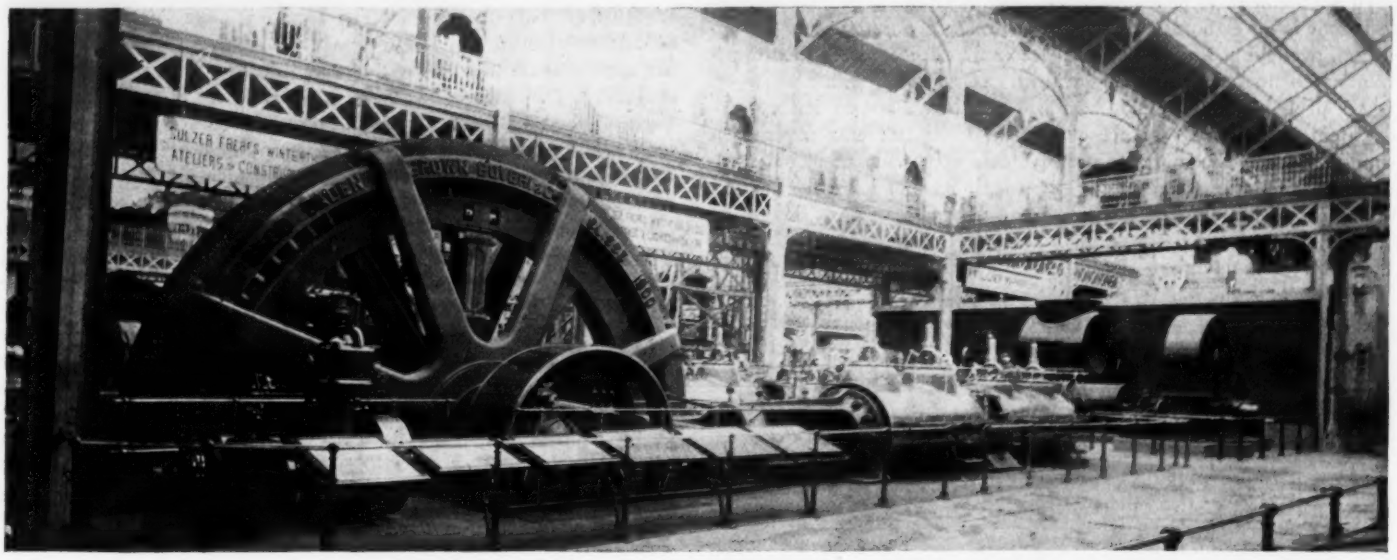
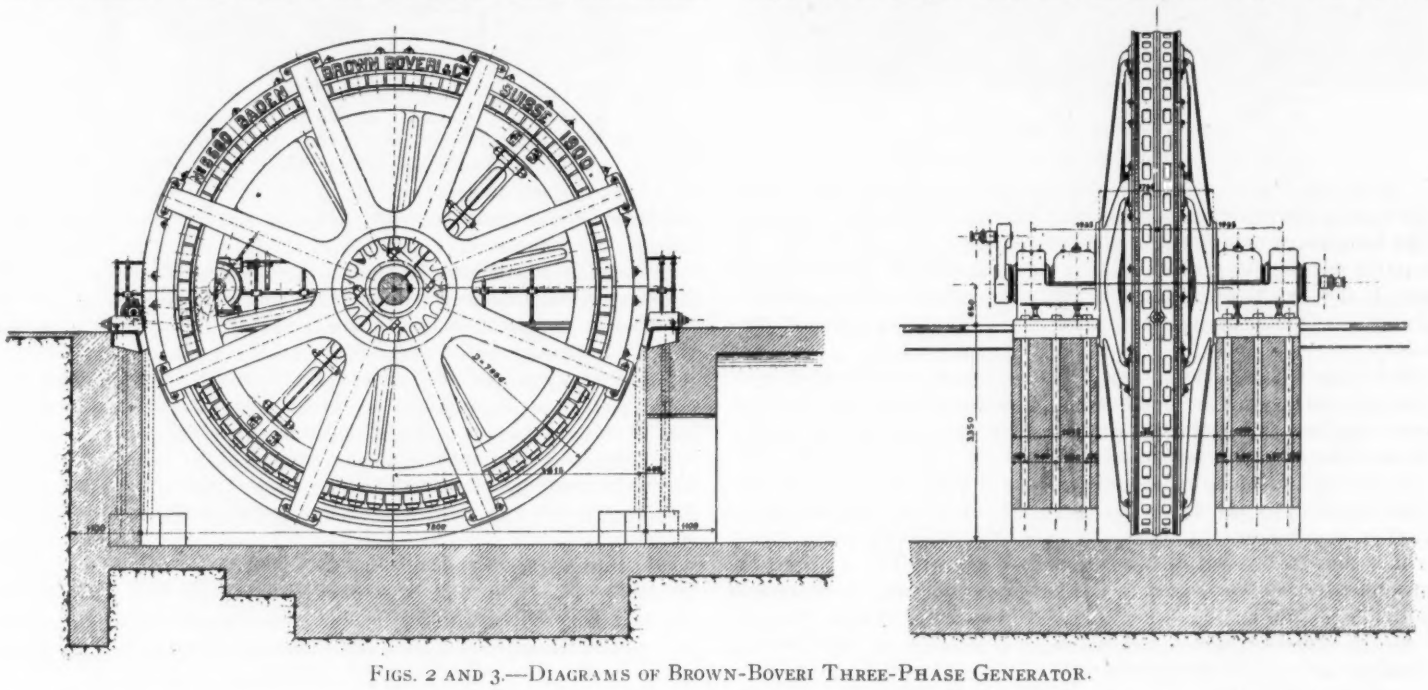


FIG. 1.—BROWN-BOVERI THREE-PHASE GENERATOR, PARIS EXPOSITION.

The whole machine is built with high finish and is easily accessible. It is driven by a triple expansion Sulzer engine from Winterthur, running at 83 r. p. m.

The same concern shows in the Russian section a 350-hp three-phase generator, 190 volts and 40 cycles per second, running at 92 r. p. m., direct coupled to an engine by Bromley, of Moscow. All over Electricity Building, Brown Boveri apparatus included as part of other apparatus, can be seen, including single, two and three-phase motors, direct current motors, while there is a 110-hp three-phase motor operating the pumping plant for the famous Trocadero cascade.

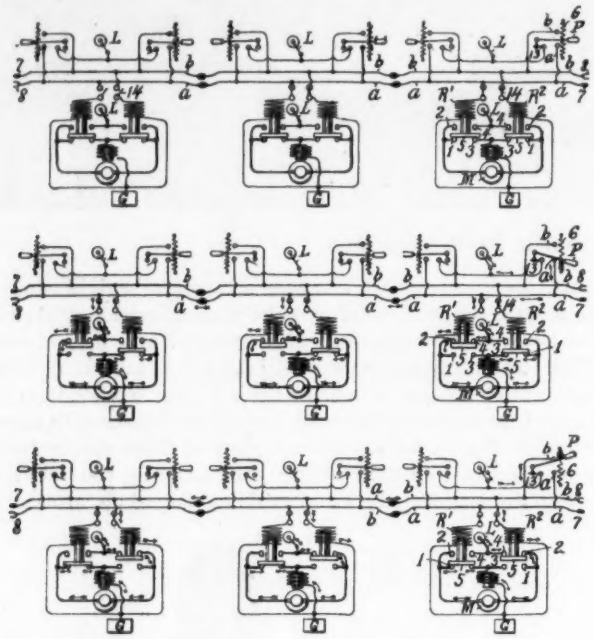
As to the features of the apparatus, it must be regarded as typical of much shown this year as the furthest reach of the art in Europe, but which is claimed by Mr. C. E. L. Brown as having been embodied since 1892 in the machines which they have developed and introduced on the Continent. These points are, fixing the magnet poles with pole pieces direct onto the rim of the heavy engine fly-wheel; the use of cylindrcal magnets with pole pieces; the use of bare copper strip wound on edgewise; the method of holding the armature core by a two-part cast-iron frame so arranged as to make a rigid construction and to be held together either by bolts passing outside or through the core or by both; hole armature with closed or practially closed holes and high tension conductors wound in seamless insulating tubes; the arrangement of the connections of the windings outside the core; the carrying of the armature frame by two spider frames with consequent stiffening of the structure; the carrying of these spider frames on trunnion rings cast on the bearings, thus ensuring concentricity with respect to the magnet wheel and enabling the whole armature to be revolved by a barring gear for ready examination. Most of these features which strike one as prominent to-day, in European work certainly, appear to date back with Mr. Brown seven or eight years. They are certainly no mean contribution to the dynamo art, whose value must be judged by the apparent universality of their application in apparatus of analogous type seen at Paris this year.



FIGS. 2 AND 3.—DIAGRAMS OF BROWN-BOVERI THREE-PHASE GENERATOR.

The Sprague Multiple-Unit Master Patents.

Neither patents nor books nor men are to be judged altogether on the basis of their sheer bulk, but size is one notable element in attracting attention, and by this mark the Sprague patents on multiple unit electric railway control are certainly conspicuous. Last week there were issued to the distinguished inventor, Mr. Frank J. Sprague, and by him assigned to the Sprague Electric Company, two patents, one No. 660,065, on a "traction system," and the other, No. 660,066, on a "method of regulating motors." The first named is the broad multiple unit system, while the second is in the nature of a corollary. The traction patent includes no fewer than 20 sheets of drawings which supplement 39 pages of patent specification. The preamble of the patent is an elaborate and really impressive discussion of the invention, occupying 22 pages, while the remainder of the document is given up to no fewer than 263 claims. If anything has been overlooked, probably neither Mr. Sprague nor Mr. Thomas Ewing, Jr., his patent attorney, are at present aware of it. Here at any rate is ground work on the multiple unit system, with which, in contradistinction to the old method of hauling a train by a locomotive, the new electric art of building up a train from individual units is contained. The monarchical system of steam yields way to the federal system of electricity. This is one of the most important patents issued in many a long day, and one has to go back to the issuance of the Tesla polyphase patents to find anything equalling it in possible influence upon



FIGS. 1, 2 AND 3.—MULTIPLE UNIT SYSTEM.

the railway art and the development of the electric railway industry. The fortunes of this patent in view of the fierce struggle it seems inevitably destined to provoke will be watched with the keenest interest. It is stated that the patent is valued very highly by the Sprague Company and will be vigorously maintained when and wherever necessary.

It is simply impossible in these columns to find space for more than a merely cursory notice of this remarkable invention which has now been in actual and successful use for some time, and for which Mr. Sprague's application dates back to April 30, 1898. Hence the general idea is quite familiar to our readers, and has in fact been publicly discussed by Mr. Sprague in papers and articles. We reproduce Figs. 1, 2 and 3 and 73 (Fig 4) of the drawings and seven claims. Fig. 1 shows a system of control on open circuit, Fig. 2 shows the grouping for movement ahead, Fig. 3 shows conditions for movement astern, and Fig. 4 (73) is a plan view showing the wholly equipped car. In summing up his description of principle and methods, Mr. Sprague says: "The practical result of the system developed in the foregoing specification and in the drawings illustrating it when applied in its entirety is that cars properly equipped can be made up interchangeably into a train of any length and can be operated from any one of a number of points and that all an operator has to do in order to effect definite movements of the train as to acceleration, speed and direction is to make movements of his hand at any one of the operator's switches, which will be similar under the conditions that usually arise in practice. In short, a car is a unit, and a train composed of a number of similarly equipped cars is also a unit having the same general characteristics that a single unit has, preferably without any conditions being imposed as to the number, order or end relation of the units comprising the train. This same general statement applies to the operation of a train made up of cars some or all of which are but partially equipped, but which together are provided with an operative train equipment. To effect this fundamental result practically, it has been necessary to provide for properly connecting the cars, preferably independently of sequence, number and end relation, with couplings of such character that any train-hand can effect the coupling; to provide against cross connections in the circuits on the different cars; to guard against accidents due to failure of circuits or current or otherwise; to secure practical uniformity of operation in the apparatus on the different cars and equality of work in the various motors, and to secure simplicity and flexibility in the relation of the parts under all the various conditions of operation. To accomplish this, a system has been devised which is in part automatic and includes two sets of circuits, by means of which all or parts of the apparatus on the various units or for the various equipments is operated through local means whose action is initiated through a governing line and master controllers whatever the nature of the intermediate apparatus or the specific construction of the controlling apparatus. In the numerous claims herein presented it has been attempted to cover as fully and broadly as possible those characteristics of the system which are required to render the fundamental conception possible of accomplishment or which are of advantage in point of commercial economy, efficiency, or safety. It is obvious that partial advantage may be taken of this system without adopting it in its entirety, and that the various elements can be greatly modified without losing the advantages gained by the fundamental combinations, systems and methods of operation. Many changes can be made without departing from the spirit of my invention."

Just which of all the claims will prove the most vital, it would be impertinent here to predict. The first six run thus:

1. In an electrical train system, the combination of translating devices and circuits therefor in parallel relation with each other, and a governing train line independent of the other circuits, substantially as described.

2. In an electrical train system, the combination of translating devices, circuits therefor, and a governing train line independent of

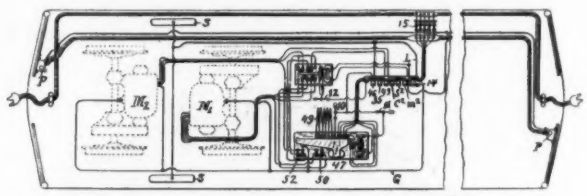


FIG. 4.—MULTIPLE UNIT SYSTEM.

the other circuits provided with sets of controlling wires, substantially as described.

3. In an electrical train system, the combination of motors, circuits therefor, an independent governing train line consisting of two sets of train wires, one set for determining direction and one set for speed regulation, substantially as described.

4. In an electrical train system, the combination of motors, circuits therefor, an independent governing train line consisting of two sets of train wires, one set for determining direction and one set for speed regulation, suitable contacts controlled by these wires, and means for holding closed the direction-controlling contacts, and means for opening and closing the contacts for regulation at will, substantially as described.

5. In an electrical train system, the combination of translating devices and circuits therefor in parallel relation with each other, a governing train line independent of the other circuits, and relays connected with the governing train line in parallel circuit with each other, substantially as described.

6. In an electric train system, the combination of motors, circuits therefor, controllers therefor, and an independent governing train line with relays for operating the controllers, substantially as described.

The 263d and last claim is thus phrased: "An electrically equipped train having independent direction and speed-controlling circuits, substantially as described."

Black Belt Electricians.

PROF. ARTHUR U. CRAIG.

There is a phase of electrical development at one particular point in the Southern States that is as deserving of description and record as the undertakings some account of which have recently appeared in these columns. What we have particular reference to now, however, is the education and training of a number of ambitious young negroes as practical electricians the well-known Normal and Industrial Institute, Tuskegee, Ala., of which Mr. Booker T. Washington, the acknowledged leader of the colored race in this country, is founder and president.

Incidentally it may be stated that, eighteen years ago, after Mr. Washington had graduated from the Hampton Institute in Virginia, he began his great work of education among his own race right in the heart of the Black Belt, Alabama. By force of character and devotion to a high ideal, through the passing years, that remarkable man has been enabled to extend his work, until at the present time he is at the head of an institution wherein over 1200 colored youths and maidens from every part of the United States, including Cuba, Porto Rico and the Philippine Islands, are being fed, clothed and trained in no less than 26 different trades, professions and industries, embracing about every calling intermediate between and including preaching and brick-making.

The working plant of this institute has today a real estate market value of nearly $500,000, every building belonging to it having been designed and constructed by the students themselves, while all the necessary supplies are raised on the farm—nearly 30,000 acres, all told—which is worked on the most scientific principles, the young colored professor of agriculture being the great authority on scientific farming in that part of the country.

Among these various trades is that of electrical engineering, the course in which is being taken by about a dozen students at the present time; and inasmuch as during the past few years some rather interesting work has been undertaken and successfully accomplished by these youths, under the direction of their professor whose portrait accompanies this article, it cannot fail to be of interest to the workers in the field of electrical engineering to learn something about the young negroes of the South, who, when properly trained, make splendid mechanics, from one who had the privilege of seeing them at their work not many weeks ago.

It was in December, 1895, that Arthur U. Craig, a recent graduate at the Kansas State University, Lawrence, Kan., relinquished his position as assistant to Prof. L. I. Blake, who was in charge of the electrical department in that university, to take charge of the electrical engineering department at the Institute in Tuskegee, Ala. Up to that time electrical mechanics, etc., had not been included in the curriculum of the Tuskegee Institute; but President Washington, solicitous that his boys should be afforded opportunities for qualifying to enter so promising and remunerative a sphere, determined upon the establishment of a chair of electrical engineering and appointed Mr. Arthur Craig as its first occupant.

Thus far the Tuskegee had not enjoyed any of the advantages electricity affords as a medium for the distribution of light and power. The first duty of the newly appointed professor, therefore, was to get a mechanical plant or machine shop equipped in which his students could have practical training. Already steam engineering was being studied by a large class of students, and in their well-equipped shops and foundry quite a number of first-class engines of various types and capacities had been built and installed by the makers in various parts of the South.

With the addition of a number of special tools as auxiliaries to the existing machine shops, work of an electrical character was begun, and the boys who promptly entered the new department were not there long ere they were put to do practical work in their special line.

Oil lamps wherewith to illuminate the extensive grounds and the innumerable buildings, including dormitories, workshops, dining-hall, class-rooms, libraries, teachers' residences, farm buildings, mills, factories, etc., etc., were the only available medium, so an electric lighting plant was quickly decided upon. Professor Craig planned the building for the central station, and through the generosity of several of the leading manufacturing companies the requisite pieces of electrical apparatus were donated and the work of installation entered upon.

The plant thus first installed consisted of one 50-kw monocycle, 60-cycle machine, G. E. type, connected with an exciter and driven by a Westinghouse engine, with all the necessary adjuncts. The switchboard is of white marble of the G. E. type, and equipped with G. E. instruments, including ammeters, voltmeters, lighting arresters, two- and three-pole knife switches, compounding rheostats for both dynamo and exciter, etc. For several years this plant was found amply sufficient for the service it had to render, but the phenomenal growth of the Institute and the increasing demand for more light and power has necessitated the planning of a new, larger and more central station to be built and installed in the beautiful grounds of the Institute.

The new station is now under way, and will be the work throughout—designing and building—of the students, who, in this case, as in the case of every other building on the grounds, will hew the timber in the woods, haul it to their sawmill, cut it, work it and put it together, as will also be done with the bricks, millions of which are made year by year by the students, not only for sale, but for their own buildings.

FIG. I.—ERECTING A POLE LINE.

The engine for running the new station will be of 150-hp capacity, with boilers for same, feed-water heaters and every other appliance for making the plant complete.

From the very inception of this electrical department no extraneous help has ever been had, the installing of the plant, construction of pole line about the grounds, wiring of buildings, installing of fixtures, all being done by the students, whose aptitude has been most remarkable. The existing plant furnishes current for lighting the grounds and for six of the buildings, including class-rooms, dormitories and all the executive offices. One of the accompanying cuts shows the boys erecting a pole line.

Two years ago a large and handsome church edifice was erected in a remote part of the grounds, nearly half a mile from the generating station. The plans were prepared by one of the students. It has a seating capacity for nearly 3000 persons, and is up to date in every respect.

Not only did the students make the million and a half of bricks and build them into the 2-ft. walls, but they equipped the edifice with a unique system of steam heating and installed a fine and artistic system of electric lighting throughout, which shows off the striking interior to great advantage.

At the outside of the main entrance to the church is a 1200-cp, alternating, enclosed arc lamp of the G. E. type; while the interior is equipped with three large electroliers (Frink type), each one having 36 16-cp incandescent lamps; in the apse, where sits the large choir, immediately behind the speaker's rostrum, along the frieze, is a row of lamps. There is a pulpit lamp, and around the church, at convenient points, handsome wall brackets are used, the entire effect being very attractive.

In view of the growing demand for current, and the new generating station being well under way, the students in the electrical department are now at work building a large dynamo with capacity sufficient to light the entire Institute and grounds. This machine is to be of the multipolar type; the castings for it have been made in their own foundry from models made in the pattern shop. The only feature in the machine that will not be strictly home-made will be the laminated plates for the armature, which have been donated by the Bullock Electric Manufacturing Company. There is also being built by the students a small, direct-current dynamo having a capacity of 125 10-volt, 16-cp lamps.

In thus undertaking the entire modeling and building of dynamos in the Institute rather than purchasing them or securing them as gifts from generous donors, it was felt that such work would be particularly valuable to the students, by enabling them to learn in a practical way the fundamental principles of electrical and mechanical construction.

The three-wire system is in general use thus far, and for the purpose of reducing the initial voltage of the current which leaves the

FIG. 2.—STUDENTS, TUSKEGEE INSTITUTE.

station as a 10,400-volt current, to 208 volts, G. E. transformers, H type, are used. All wires are laid in wood mouldings, and these mouldings, like everything else, are made by the students themselves. There is not a single boy in the department but gets practical experience in every department or branch of the work. The plan pursued is to have the boys engage so many hours every day in actual work, either in the construction department proper, or wherever work is in progress about the Institute; the remainder of the time outside of what are strictly school hours, when academic studies only are engaged in, is devoted to study of the various problems which from time to time present themselves for solution, or the theory of electricity is studied.

It is within the range of probability that inasmuch as the small city of Tuskegee, within half a mile of the centre of which the Industrial Institute is located, is not yet lighted by electricity, some day in the near future the Institute may undertake to build a central station, or else to supply the city with current as a business enterprise. Further, since the teaming between the railroad station and the Institute is something enormous, and calls for the regular use of quite a long string of mule-teams, an electric railway from the steam railroad track direct to the Institute, if not indeed the electrical equipment of the dummy railroad, five miles long, which connects Tuskegee with Cheehaw Junction on the main line of the Western Railway of Alabama, may some time in the near future be determined upon. Such an undertaking would prove of immense advantage and profit not only to the citizens of Tuskegee itself, but the Institute and likewise the students in the electrical department.

It may also be stated that in that particular district or section of the country where lightning storms of the most terrific character are very frequent, especially in summer time, serious havoc is often wrought by the subtle fluid; but all through the system as installed at Tuskegee, Professor Craig has made a liberal use of the best and most efficient type of lightning arrester, with the result that thus far there has never been any mishap or disaster of whatever character; and it may be stated that all the work, though done by these colored lads exclusively, is strictly first-class in every detail, for every building is fully insured, and the electrical construction work, both exterior and interior, is done according to the rules and requirements and subject to the most critical examinations of the expert inspectors of the National Underwriters' Association.

Professor Craig, though only 28 years of age, is a most accomplished electrical engineer, enthusiastically devoted to his profession and gratified with the manner in which his students take to their studies and work and the progress they are making. He is the first young negro who ever graduated from any institution as an electrical engineer; and with his splendid college record in the past, the success of his work in the present, and his enthusiastic and sanguine hopes for the future, he is achieving distinguished success for the race of which he is a talented member.

Elements of Illumination—XIII.

BY DR. LOUIS BELL.

OIL LAMPS. Oils other than kerosene are used in this country only to a very slight extent, the latter having driven out its competitors. Sperm oil, and, abroad, colza oil (obtained from rape seed), are valued as safe and reliable illuminants for lighthouses, and in some parts of the Continent olive oil is used in lamps, as it has been since time immemorial.

FIG. 1.—"LUCIGEN" TORCH.

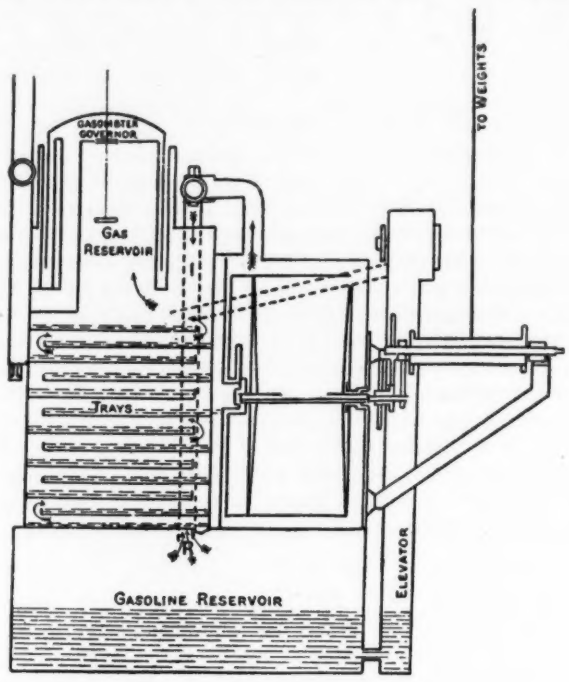
Here, kerosene is still the general illuminant outside of the cities and larger towns. It has the merits of being cheap (on the average 12 cents to 15 cents per gallon in recent years), safe, *if of the best quality*, and of giving, when properly burned, a very steady and brilliant light. All oils require a liberal supply of air for their combustion, particularly the heavier oils, and many ingenious forms of lamp have been devised to meet the requirements. On the whole, the most successful are on the Argand principle, using a circular wick with air supply both within and without, although some of the double flat-wick burners are admirable in

FIG. 2.—"ROCHESTER" LAMP.

their results. A typical lamp, the familiar "Rochester," is shown in Fig. 2, which sufficiently shows the principle involved. In kerosene lamps the capillary action of the wick affords an ample supply of oil, but with other oils it has proved advantageous to provide a forced supply. The so-called "student lamp," with its oil reservoir, is the survival of an early form of Argand burner designed to burn whale oil. In other instances clockwork is employed to pump the oil, and sometimes forced air supply as well.

Kerosene lamps usually are designed to give from 10 to 20 candle-power, and occasionally more, special lamps giving even up to 50 or 60 candle-power. The consumption of oil is generally from 50 to 60 grains per hour per candle-power. As kerosene weighs about 6.6 pounds per gallon, the light obtained is in the neighborhood of 800 candle-hours per gallon. This brings the cost of the candle-hour down to about 0.018 cent, taking the oil at 15 cents per gallon. No illuminant save arc lights and mantle burners with cheap gas can compare with it in point of economy.

A very interesting and valuable application of oil lighting is found in the so-called "Lucigen" torch. The oil, generally one of the heavier petroleum products, is carried under air pressure in a good sized portable reservoir, and the oil is led, with the compressed air highly heated by its passage through the apparatus, to an atomizing nozzle from which it is thrown out in a very fine spray, and is instantly vaporized and burned under highly efficient conditions. These "Lucigen" torches give nearly 2000 candle-power on a comsumption of about two gallons of oil per hour, burning with a tremendous



SECTION THROUGH A.B × A.B.

FIG 3.—SECTION OF TYPICAL AIR GAS MACHINE.

flaring flame three feet or more in length and six or eight inches in diameter. They are very useful for lighting excavations and other rough works by night labor, being powerful, portable and cheap to operate. Fig. 1 gives an excellent idea of this apparatus in its usual form. Such a device is only suited to out-door work, but it forms an interesting transitorial step toward the air-gas illuminants which have come into considerable use for lighting where service mains for gas or electricity are not available, or where the conditions call for special economy.

Air Gas.—It has been known for seventy years or more that volatile hydrocarbons could be used to enrich poor coal gas, and that even air charged with a large amount of such vapor was a pretty good illuminant. Of late years this has resulted in the considerable use of "carburetters" which saturate air with hydrocarbon vapor, making a mixture too rich to be in itself explosive and possessing good illuminating properties when burned as gas in the ordinary way. The usual basis of operations is commercial gasoline, which consists of a mixture of the more volatile paraffin hydrocarbons, chiefly hexane and iso-hexane. The process of gas making is very simple, consisting merely of charging air with gasoline vapor. Fig. 3 shows in section a typical air-gas machine. It consists of a large metal tank holding a supply of gasoline, a carburetting chamber of flat trays over which a gasoline supply trickles, a fan to keep up the air supply and a little gas reservoir in which the pressure is regulated and from which the gas is piped. The fan is driven by heavy weights, wound up at suitable intervals. The whole gas machine is usually put in an underground chamber, both for security from fire and to aid in maintaining a steady temperature. Four to six gallons of gasoline are required per 1000 cu. ft. of air, and the result is a gas of very fair illuminating power.

The cost of this air gas is very moderate, but on account of the cost of plant and some extra labor, it is materially greater than direct lighting by lamps. It is a method of lighting very useful for country houses and other places far from gas or electric supply companies. The principal difficulty is the variation of the richness of the mixture with the temperature, owing to change in the volatility of the gasoline, a fault which is very difficult to overcome. At low temperatures there is a tendency to carburet insufficiently and to condense liquid in the cold pipes. The gas obtained from these machines is burned in the ordinary way, although burners especially adapted to such gas are extensively employed.

Coal Gas.—In commercial use for three-quarters of a century, coal gas was, until about twenty years ago, the chief practical illuminant. Little need here be said of its manufacture, which is a department of technology quite by itself, other than that it is obtained from the destructive distillation of rich coals inclosed in retorts from which it is drawn through purifying apparatus and received in the great gasometers familiar on the outskirts of every city. The yield of gas is about 10,000 cu. ft. per ton of coal of good quality. The resulting gas consists mainly of hydrogen and of methane (CH_4) with small amounts of other gases, the composition varying very widely in details while preserving the same general characteristics. A typical analysis of standard coal gas giving 16 to 17 candle-power for a burner consuming 5 cu. ft. per hour would be about as follows:

Hydrogen	53.0
Paraffin hydrocarbons	33.0
Other hydrocarbons	3.5
Carbon monoxide	5.5
Carbon dioxide	0.6
Nitrogen	4.2
Oxygen	0.2
	100.0

Ammonia compounds, carbon dioxide and sulphur compounds are the principal impurities which have to be removed. Traces of these and moisture are often found in commercial gas.

In point of fact, at the present time but a small proportion of the illuminating gas used in this country is unmixed coal gas, such as might show the analysis just given. Most of it is water gas or mixtures of coal and water gas. Water gas is produced by the simple process of passing steam through a mass of incandescent coal or coke and breaking up the steam thus into hydrogen and oxygen, which latter unites with the carbon of the coal, forming carbon monoxide. At moderate temperatures considerable carbon dioxide would be formed, but, as this is worse than useless for burning purposes, the heat is always carried high enough to insure the formation of the monoxide. The hypothetical chemical equation is:

$$H_2O + C = CO + H_2.$$

The reaction is never clean in so complete a sense as this, some CO_2 always being formed. This water gas as thus formed is useless as an illuminant, and requires to be enriched by admixture of light-producing hydrocarbons—carburetted, in other words. This is done by treating it to a spray of petroleum in some form and at once passing the mixture through a superheater which breaks down the heavier hydrocarbons and renders the mixture stable. There are many modifications of this system worked on these general lines. The enriching is carried to the extent necessary to meet the legal requirements, usually producing gas of 12 to 15 candle-power for a 5-ft. jet. A typical analysis of the water gas after enriching would show about the following by volume:

Hydrogen	34.0
Methane	15.0
Enriching hydrocarbons	12.5
Carbon monoxide	33.0
Oxygen, nitrogen, etc	5.5
	100.0

The enriching process, *i. e.*, superheating and breaking up the heavy hydrocarbons in the form of vapor, is substantially that used in making Pintsch and allied oil gas, so that commercial water gas may be

regarded as a mixture of water gas and oil gas. Water gas, when properly enriched, is the equivalent of coal gas for illuminating purposes. The main difference between them is the very large proportion of carbon monoxide in the water gas, which adds greatly to the danger of leaks. For this carbon monoxide is an active poison, not killing by asphyxia, but by a well-defined toxic action peculiar to itself. Hence persons overcome by water gas very frequently die under circumstances which, if coal gas were concerned, would result merely in temporary insensibility. As the enriched water gas is cheaper than coal gas, however, the gas companies maintaining that gas is not furnished for breathing purposes, supply it unhesitatingly, sometimes openly, sometimes without advertising the fact. Very large quantities of so-called coal gas contain enriched water gas to bring up their illuminating power. In these cases the carbon monoxide is in much less proportion, perhaps 12 to 15 per cent. It is often stated that water gas is doubly dangerous from its lack of odor. The unenriched gas is practically odorless, but when enriched the odor, while less than that of coal gas, is sufficiently distinctive to make a leak at once perceptible.

Power Factor Indicator.

BY AUG. J. BOWIE, JR.

THE power factor of an alternating system, is the ratio of the true watts, as measured by a wattmeter, to the apparent watts, as measured by multiplying the volts by the amperes delivered. So in order to determine the power factor correctly, in all cases, it is necessary to make three observations, and then to make a multiplication and a division—a somewhat tedious process, and one into which several errors may enter. It is possible, however, to construct one instrument which will indicate the power factor directly, on a scale suitably calibrated. In fact, the angle of lag of the current can be reproduced on the indicator dial. Such an instrument, as devised by the writer, will be described later. It is based on the assumption of sine curves of current, and voltage; but even when these curves are considerably distorted, the results will be quite accurate. In all that follows the assumption of sine waves of current and of voltage will be made. Under these circumstances, the power factor becomes the cosine of the angle of lag or lead of the current.

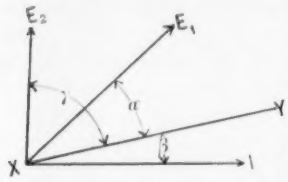


FIG. 1.—DETERMINATION OF ANGLE OF LAG.

Suppose that I (Fig. 1) represents in phase and in magnitude a current, and that E_1 and E_2 represent voltages, and that it is desired to find the angle β, by which I lags behind any given phase position XY. If the current I be passed through the current coil of a wattmeter, and the voltage E_1 through the voltage coil, the reading of the wattmeter will be $W_1 = IE_1 \cos(\alpha + \beta)$.

If E_2 be substituted for E_1, the wattmeter will read $W_2 = IE_2 \cos(\beta + \gamma)$.

Now, suppose that the ratio E_1/E_2 is known, and that the phase relations of E_1 and E_2, with reference to XY—in other words, the angles α and γ, are known—though the actual values of E_1, E_2 and I are unknown. Let $E_1 = KE_2$. Then $W_1/W_2 = K \cos(\alpha + \beta) / \cos(\beta + \gamma)$. Let the ratio of the wattmeter readings, $W_1/W_2 = R$. Then, this equation reduces to: $\tan\beta = (R\cos\gamma - K\cos\alpha) / (R\sin\gamma - K\sin\alpha)$... Eq. (1). Hence, since K, R, α and γ are known, $\tan\beta$ is determined; and hence the power factor, $\cos\beta$ is known.

This is the general case of the method to be used. From this it is evident that the ratio of the two wattmeter readings determines directly the power factor. If these two readings are nearly alike, and one wattmeter is used, the error of the instrument will be eliminated, and hence this method possesses many advantages over the wattmeter voltmeter, ammeter method. However, it is not necessary to take two wattmeter readings, and then to take the ratio; for one instrument can be constructed to do all this at once, and, knowing the conditions under which it is to be used (*i. e.*, knowing K, α and γ), a scale can be placed on it which will show directly the power factor by the position of the pointer. So that the problem resolves itself into getting an instrument which will register the ratio of two wattmeter readings.

This may be accomplished either mechanically or electrically. A mechanical arrangement could be made by balancing the torque of the two wattmeters, by having the leverage about the axis of one decrease while the other increased. However, a much better arrangement can be made to operate electrically. Let AA (Fig. 2) be the current coil of a wattmeter. Let B, a flat coil, be in series with the potential resistance of the wattmeter. B is mounted on a shaft S, which is free to turn. Let the current I be passed through AA, and let the voltage E be applied to the voltmeter coil. Let φ be the phase difference between I and E. Then the pull F of the couple (Fig. 3), acting on the coil B, tending to turn it, is proportional to $IE\cos\varphi = W$. The lever arm of this couple depends on the position of the coil, and is proportional to $\sin\delta$. Hence, the torque is proportional to $W\sin\delta$.

FIG. 4.—POWER FACTOR INDICATOR.

Now suppose that there are two such wattmeters, one of which is placed vertically over the other, the same shaft serving for both the moving coils. Also suppose that the two coils are so mounted on the shaft that the vertical planes in which they lie make an angle ε with each other. Connect the current coils in series and pass the current I through them, and apply the voltages, E_1 and E_2, respectively, to the voltage coils. The shaft will take up a position such that the two torques will balance, and hence $W_1 \sin\delta_1 = -W_2 \sin\delta_2$; δ_1 and δ_2 being the angles which the movable coils make with the line CD. But $\delta_1 - \delta_2 = \varepsilon$. Hence $R = -\cos\varepsilon + \sin\varepsilon \cot\delta_1$..(2). Hence ε being a constant, R is dependent on δ_1 alone, and hence on the position of the shaft. Substituting this value of R in Eq. (1) will give an equation in which β and δ_1 are the only variables. From this resulting equation, the scale to affix to the power factor indicator can be made out. However, the meter may have its scale determined by calibration, instead of going to all this trouble.

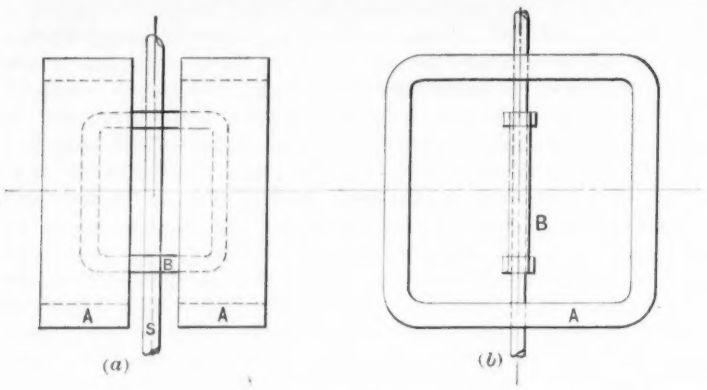


FIG. 2 (a) (b) (c).—POWER FACTOR INDICATOR.

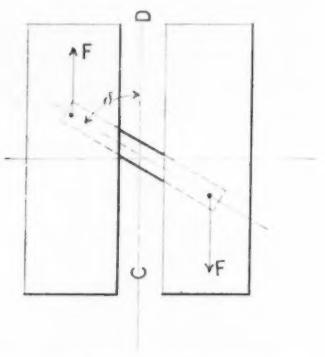


FIG. 3.—POWER FACTOR INDICATOR.

It is not necessary to have two sets of field coils, since the two movable coils may be mounted together and have the same field serve for both. In deducing Eq. (2), the field was assumed to be uniform. While this is not strictly true, still, by properly calibrating the instrument, errors due to this cause would be avoided, and the results should be quite accurate.

Having now considered the general case, the next thing is to show the application in special cases. In the case of single-phase work there is only one voltage to use. However, by replacing the resistance in series with one of the coils B by an inductance, the current in

this coil will lag behind the current in the other coil. Though it is impossible to get 90 degs. lag, still this limit may be approached, and whatever combination of resistance and inductance be used, the phase position, and the strength of the current, relatively to the current in the other armature coil, may be obtained. This arrangement would be satisfactory, provided the speed of the generators remained constant. But, with varying speed, the current through the inductance would vary inversely in the same proportion, and consequently the readings would be incorrect.

While this same method may be used for polyphase work, still, by using the voltages obtained from the different phases, and doing

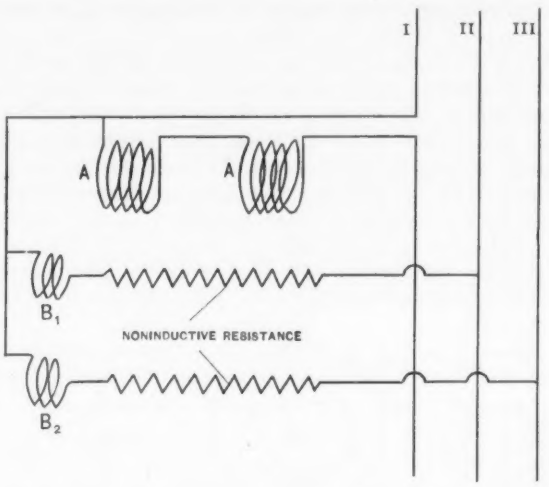


FIG. 5.—DIAGRAM OF CONNECTIONS FOR THREE-PHASE WORK.

away with the inductance, more satisfactory results can usually be obtained. It is true that this method makes the assumption that the voltages are symmetrical, and make the theoretical angles with each other. Still, as a rule, this assumption will be sufficiently close for all practical purposes. If K be unity, and ε be taken as equal to $180° + \gamma - \alpha$, then the angle of lag of the current will be reproduced exactly on the indicator in all cases. Hence in this event, by marking the cosines of the angles, instead of the angles on the scale, the instrument will read power factors. To see the application to polyphase work, several cases will be considered:

I. *Two-Phase Systems.*—To find the power factor, let E_1 be the voltage which produces the current I; and let E_2 be the other phase. Then $\alpha = 0$; $\gamma = \pm 90°$ $K = I$; and Eq. (1) becomes: $tan\ \beta = + I/R$. By Eq. (2), $cot\ \beta = \pm (cos\ \varepsilon - sin\ \varepsilon\ cot\ \delta_1)$. If the two armature coils be set at right angles, $\varepsilon = \pm 90°$, and $cot\ \beta = \mp cot\ \delta_1$. Hence δ_1 and β become equal, and hence the angle of lag is reproduced exactly on the dial of the indicator.

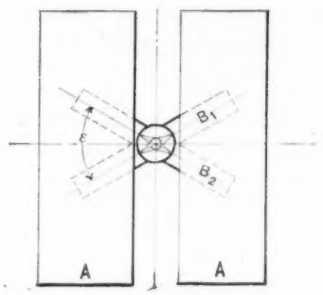


FIG. 6.—PLAN OF POWER FACTOR INDICATOR.

II. *Three-Phase Systems.*—Let ABC (Fig. 4) be the voltage triangle—the order of rotation being shown by the arrow. The angle of lag of the current in any leg is the angle by which the current lags behind the bisector of the same lettered vertex of the triangle. Let the problem be to find the lag of the current in the A leg and hence the power factor.

Case (1). Let $AB = E_1$; and $AC = E_2$. Then $\alpha = + 30°$; $\gamma = - 30°$; $K = I$; and Eq. (1) becomes: $tan\ \beta = \sqrt{3}\ (I - R)\ /\ (I + R)$ $R = cos\ (30° + \beta)\ /cos\ (30° - \beta) = - sin\ (\delta_1 - \varepsilon)\ /sin\ \delta_1 = cos\ (30° + \delta)$ $/cos\ (30° - \delta)$ where $\delta = \delta_1 - 60°$ and $\varepsilon = 120°$. Hence, by placing the coils at an angle of 120° apart, and connecting up properly, the angle of lag is reproduced on the indicator.

Case (2). Let $AB = E_1$; and $BC = E_2$. Then $\alpha = + 30°$; $\gamma = - 90°$; $K = I$; and Eq. (1) becomes: $tan\ \beta = \sqrt{3}\ /\ (I + 2R)$. It can be similarly shown that if $\varepsilon = 60°$, then $\delta_1 = \beta$.

Of course, with polyphase systems, by properly combining the voltages, any phase and any intensity of voltage can be produced. So that if an instrument were constructed for one kind of polyphase work, it could be used with any other kind, without a change of scale, by simply arranging transformers so as to give the voltages of the proper intensity in the proper phase.

An Interior Telephone System.

A great deal of work is now being done in the introduction of interior telephone systems, and various improvements are from time to time brought forward. Mr. W. M. Davis, of Chicago, has just patented an arrangement whose chief object is the provision of means whereby any subscriber whose line is not in use may be signaled from any other station irrespective of the condition of use of the line-connecting apparatus at the called subscriber's station. A further feature consists in means for preventing common batteries employed for supplying the transmitters at subscribers' stations with current from losing their current by leakage. The transmitters of a plurality of lines may be supplied with current from a common battery without danger of cross-talk. In the accompanying drawing, four stations are equipped with suitable interconnecting apparatus in association with current supply for the signal devices and the transmitters.

The stations 1^a, 2^a, 3^a and 4^a are provided with interconnecting apparatus in the form of connecting plugs a a and line-contacts springs b b. Thimbles 1, 2, 3 and 4, which serve to guide the plugs into engagement with line-contacts, are provided in front of said contacts, the thimbles being numbered to correspond with the stations. For example, if the subscriber at station 1^a should desire communication with the subscriber at 2^a, the plug at station 1^a is inserted within the thimble marked 2, or if connection is desired with station 3^a the plug is inserted within the thimble marked 3. The station 2^a may likewise communicate with station 1^a upon the plug at station 2^a being inserted in the thimble marked 1 or with 3^a upon the insertion of the plug in the thimble marked 3. The line-springs b b are connected with lines c c, each of which includes the retardation-coil d near the

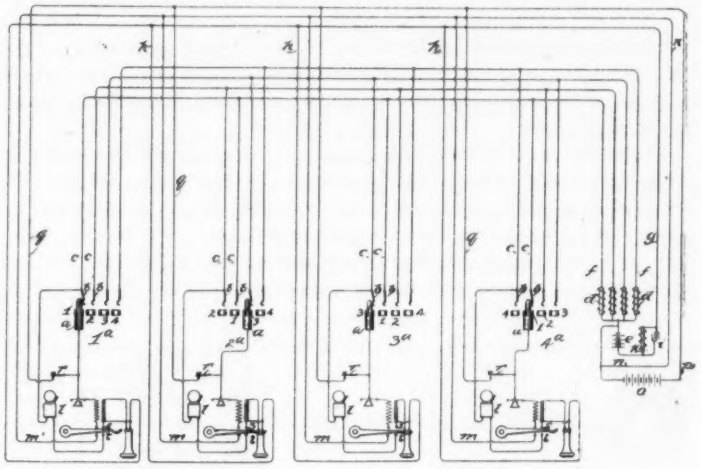


DIAGRAM OF INTERIOR TELEPHONE SYSTEM.

talking battery e, these retardation coils being included between the common battery and the lines of the nearest station, so that the battery may be fed through the retardation coils, these same coils serving to prevent the voice currents from being shunted past connected stations. The conductors ff, which constitute extensions or continuations of the conductors c c, have the terminals next to the battery e grouped, the grouped ends having common connection with one terminal of the battery, so that a single battery may pass current to a number of lines. By interposing the retardation coils between the common ends of the lines united with the common battery voice-currents are prevented from passing from one line to the other through this common connection. The remaining terminal of the battery e is connected with the conductor g, branches of which conductor include the receivers at the subscribers' stations, each branch terminating in an alternate contact s, which is engaged by the switch-hook at the corresponding station when the receiver is lifted. These branches may form electrical continuations of the branches c through the agency of inserted plugs, each of which is connected with an alternate contact, adapted also for engagement with a corresponding switch-hook when the receiver is removed, the transmitter and the primary of the induction-coil being included between the contact and the inserted plug. The secondary of each induction coil is included in circuit with the corresponding branch h. When a branch h is thus

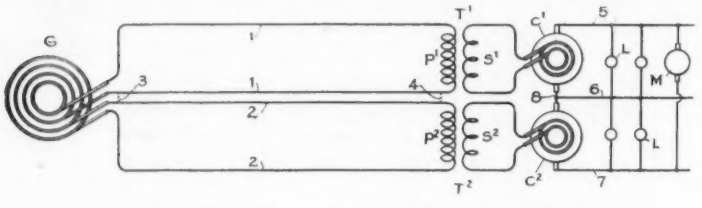
included in circuit with conductor *c*, current from the common battery is fed through the corresponding transmitter and its coil.

Mr. Davis includes a condenser *i* in the conductor *g* and shunts the same by a retardation coil *k* of sufficiently high resistance to prevent the battery *o* from normally operating the signals, while the condenser also serves to prevent the signals from being operated and permits voice currents to pass through the common conductor *g*. Signals *l* are usually audible, bells being illustrated. Each signal has one terminal permanently connected with its line *c*, the remaining terminal of the signal being in the form of a lower contact *t*, adapted for engagement with the switch-hook when the receiver is in place. A second lower contact is provided at each station, constituting a terminal of a branch conductor *m*, extending to each station from a conductor *n*, that is connected with one terminal of a battery *o*, which is employed for operating the signals. A conductor *p* forms a continuation of the conductor *n* and is connected with the other terminal of the battery *o*, branches *q* extending from conductor *p* and each terminating in a contact of a signaling key *r* at each station. The lever of each signal key is connected with the plug strand at the corresponding station. When the receivers are in place upon their hooks and upon the insertion of the plug of the calling subscriber into the jack of the called subscriber, the signal at the called subscriber's station may be operated upon a depression of the calling key *r* at the calling subscriber's station, and this may be done, as will be apparent by an inspection of the drawing, irrespective of the location of the plug at the called subscriber's station. This is an important point, as users are frequently careless in restoring the plugs to their home jacks. By freeing the switch-hooks of permanent connection and by providing the two lower or normal contacts for each switch-hook, leakage is prevented from the talking battery without the employment of condensers at each station.

Transformation from Polyphase to Direct Current.

The accompanying cut illustrates a patent just granted to Mr. E. W. Rice, Jr., on means for transforming polyphase current into direst, so as to permit the current to be used for feeding three-wire or kindred systems.

In the figure, *G* indicates the source of current, and four collector-rings are shown as representing a source of two-phase current. The transmission lines connected thereto consist of two independent circuits formed of conductors 1 1 and conductors 2 2. The conductors 1 1 serve to convey an alternating current of one phase, while the conductors 2 2 carry alternating current of another phase, the currents being angularly displaced from each other by approximately 90 degs. In practice Mr. Rice maintains the two circuits independent of each other; but this is not requisite, since, if desired, two of the conductors may be consolidated, so as to form a single return-conductor. The dotted lines 3 4 indicate this alternative construction and are shown as connecting together two of the conductors 1 2.



TRANSFORMING POLYPHASE TO DIRECT CURRENT.

Transformers T' T^2 are used for securing impressed e. m. fs. for the rotary converters C' C^2. These transformers are shown as of the single-phase type, the primary P' of one transformer being supplied from the lines 1 1, while the primary P^2 of the other transformer is supplied from the lines 2 2. The secondaries S' S^2 of the transformers are independent of each other and are individually connected to the single-phase rotary converters C' C^2, the direct current terminals of which are arranged in series and connected to a three-wire direct current system. The converter C' is fed from the secondary S', while its companion converter is fed from the secondary S^2.

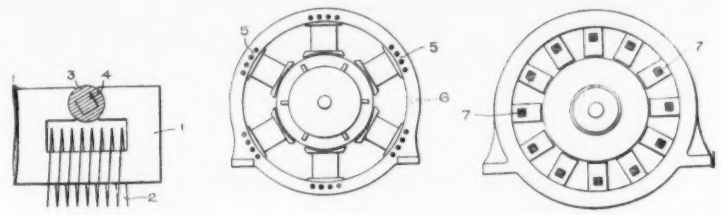
The conductor 6, which forms the neutral of the direct current three-wire system, is connected to the common connection 8 between the direct current terminals of the converters, while the outside conductors 5 7 of the three-wire system are connected to the remaining direct current terminals of the converters. Translating devices, such as lamps *L* or a motor *M*, are fed from the mains of the three-wire system, as shown. With this arrangement all the advantages of the three-wire system of distribution are obtained in connection with a transmission line in which the power is conveyed through the medium of alternating currents.

Although Mr. Rice has shown the transformers T' T^2 as of the single-phase type, it will be evident that other means for transformation may be employed—such, for example, as a two-phase transformer with a common return magnetic circuit—or, if desired, the transformers may be entirely omitted and the converters fed directly from the transmission line.

Adjusting Reluctance of Magnetic Circuits.

In 1898, Prof. Elihu Thomson applied for a patent on the interposition in any magnetic circuit of a body of laminated magnetic material so arranged that the laminæ could be placed parallel with, or at any angle to, the lines of force of the circuit. By placing them parallel the reluctance is least, and it increases to a maximum when the angle is 90 degs. Prof. Thomson has now received a patent embodying this idea, worked out as shown in Figs. 1, 2 and 3.

Fig. 1 illustrates the use with a reactance coil. Fig. 2 shows an application for the purpose of balancing up the field magnets of dynamos. Fig. 3 shows another mode of applying the invention. In



FIGS. 1, 2 AND 3.—ADJUSTING RELUCTANCE OF MAGNETIC CIRCUITS.

Fig. 1 the core consists of a laminated structure. This core either has an opening formed, as in Fig. 2, or is entirely interrupted, as in Fig. 1. The openings or cuts made in the core are such as to intercept the lines of force produced by current in the exciting coil 2. A body of laminated magnetic material 3 is arranged so as to be capable of assuming different angular relations to the lines of force or line of magnetic induction in the core. By varying the position of the core the reluctance of the magnetic circuit will be correspondingly varied, as is evident. The body of magnetic material may be in the form shown in Fig. 1, or it may be any regular-sided prism—as, for instance, square in cross-section, as in Fig. 3. If the plug is cylindrical, it may be mounted in various ways so as to turn. The walls of the opening itself may form the bearing, in which case the plug may be provided with a squared or other angular projection 4, by which it may be turned in its bearings for purposes of adjustment. The laminted magnetic material may also be mounted on a shaft carried in bearings, in a manner analogous to that of the armature of a dynamo-electric machine.

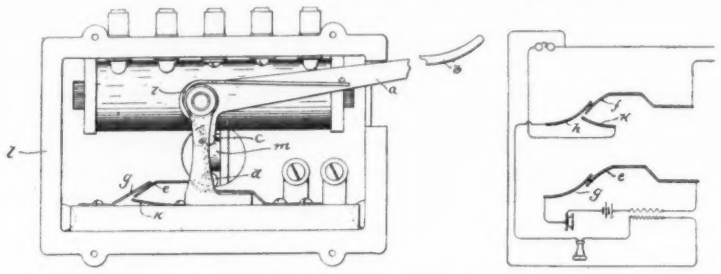
In many cases difficulty is experienced in setting up a multipolar dynamo so that the e. m. fs. generated between the different sets of brushes shall be the same. Owing to some accidental difference in the quality of iron used, or to a slightly eccentric placing of the armature with respect to the pole-pieces, or to various other causes, it may happen that the flux due to one set of poles may differ from that due to another. In such a case, if the machine is a generator, one circuit may furnish more current than another, and in exaggerated cases the current may even be reversed in some of the circuits. In the case of a motor under similar circumstances, the counter e. m. f. of the different circuits would be different, whereby some circuits would take an excessive current and others but very little. To obviate these difficulties, Prof. Thomson provides openings in some suitable portion of each of the magnetic circuits of the machine; circular in cross-section, as in Fig. 2, and may be located at the base of each pole-piece, as shown at 5, or the openings may be made in the yoke between the pole-pieces, as indicated, for example, at 6. Into these openings are inserted plugs of laminated magnetic material, with the laminæ arranged longitudinally of the openings, so as to intercept the lines of force. An end view of the laminæ is shown at 5. By turning the plug or by withdrawing the plug and inserting it at a different angle, the magnetic reluctance of the circuit is changed, and consequently the flux. With proper adjustment in the manner described the flux per pole in a multipolar machine may be equalized or otherwise altered or adjusted.

Fig. 3 shows a slightly different application of the invention. In this case the pole-pieces of a dynamo are provided with openings transverse thereto and square. By inserting a square plug 7 of laminated material so that the laminæ are either parallel to or lie across the lines of force, or by omitting the plug, an effect is obtained equivalent to inserting an air-gap of different lengths into the magnetic circuit. The air-gap becomes operative when the reduced section of the pole-piece becomes saturated. A bend in the saturation curve is produced at the point where the air-gap becomes operative. Above the bend in the curve the magnetization is no longer proportional to the magnetomotive force, and the operation of the machine is thus rendered less sensitive to change in the current in the field winding. In this latter application the laminations are made of soft iron and separated by paper or other non-magnetic material. Generally speaking, the laminæ are all formed of the same material and separated from each other by sheets of non-magnetic material, or they may be formed of material of different permeability, such as soft iron and hard steel, and suitably intermingled. Indeed, the use of non-magnetic sheets may be omitted, the unavoidable air-spaces between the laminæ being in many cases sufficient to secure the desired lack of symmetry in permeability of the laminated body.

Improved Telephone Switch Hook Mechanism.

Mr. Alfred Stromberg, of Chicago, has received a patent on an improved form of gravity switch hook for use at subscribers' stations, as shown in the accompanying cuts. In this device the parts that are frequently subject to changeable engagement are relieved of excessive friction and a positive actuation of circuit-changing spring portions is secured. Stiff springs are employed as circuit changing means, which may be readily actuated through the agency of such a hook.

The receiver supporting the hook is electrically distinct from the switching apparatus, the switch hook being in the form of a bell-crank lever hinged at its elbow to a suitable support. One arm of the bell-crank extends horizontally and is provided with a hook for supporting a receiver at its free end. The remaining arm of the bell-crank is much shorter and extends vertically from the pivotal mounting of the bell-crank. This shorter arm is provided with a roller-contact, in the form of a cylinder of insulating material, adapted for engagement with circuit-changing springs, the roller in changing its points of engagement with the springs serving as the bell-crank is actuated, to effect and permit changes in the circuit condition of the apparatus. A coiled spring surrounds the shaft where the switch-arm is pivoted, one end of the coiled spring engaging the switch-



FIGS. 1 AND 2.—SWITCH HOOK MECHANISM.

hook mounting, while the other end engages a pin upon the switch-hook, the coiled spring serving to lift the horizontal arm of the bell-crank when the receiver is removed.

Fig. 1 is a rear view of a switch-hook and containing case. Fig. 2 is a diagrammatic view illustrating the electrical connections. The telephone switch-hook is in the form of a bell-crank lever, having a long horizontal arm *a*, provided with a hook *b* for supporting the receiver. The switch arm *c* is placed substantially at right angles with relation to the arm *a* and is bifurcated at its lower end to receive a roller *d*, of insulating material. Two springs *e* and *f* are arranged for mechanical engagement with the roller, each spring being provided with an incline, through the agency of which and the engaging roller they are depressed from contact spring *g* and *h* when the longer arm of the bell-crank is depressed through the agency of the receiver when carried thereby. When the bell-crank is relieved of the weight of the receiver, the coiled spring *i* and the springs *e* and *f* serve to lift the long arm of the bell-crank, thereby permitting the springs *e* and *f* to engage the contacts *g* and *h*.

The telephone switch-hook is shown as being applied to a battery transmitter, the springs *e* and *f* serving, upon their engagement with the contacts *g* and *h*, to close circuit through the transmitter with its battery and through the telephone receiver, the spring *f* upon its elevation being at the same time removed from engagement with the lower contact *k*, which constitutes the terminal of a signalling circuit,

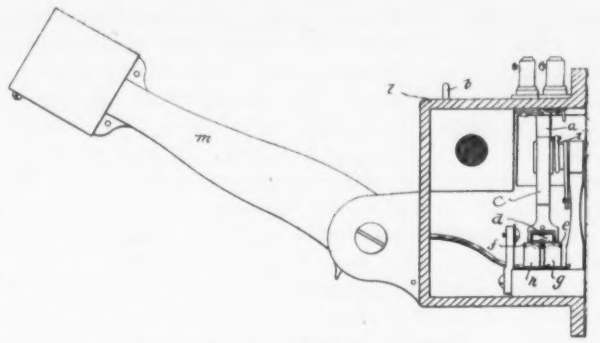


FIG. 3.—SWITCH HOOK MECHANISM.

the spring *f* being brought into engagement with this terminal when the receiver is restored, circuit through the transmitter and receiver being at the same time open.

Fig. 1 shows casing *l*, that contains the induction coil, the mounting for the receiver supporting arm and the switch parts. A swinging arm *m*, Fig. 3, is provided upon the front of the casing *l* and supports a suitable form of transmitter. In this manner Mr. Stromberg has devised an improved form of switch-supporting lever-arm that is capable of effecting the actuation of stiff springs without any appreciable frictional wear. The switch arm is free of electrical connection.

A Wire Tapping Swindle.

Two telegraph operators came near swindling the City National Bank, of Kansas City, out of $5,500 recently by a daring scheme of wire tapping. A man who gave his name as R. F. Reed several days ago appeared at the Commercial Bank, of Lawson, a small town between Chillicothe and Kansas City, with a check made payable to himself and drawn on the City National Bank, of Kansas City. Payment was refused. This man and his partner tapped the wires a half mile south of Lawson one night recently and sent a message to the cashier of the City National Bank, of Kansas City, asking that he ship on a Chicago, Milwaukee & St. Paul train the next morning, without fail, $5,500, and signed the name of the Commercial Bank, of Lawson, to the message. The cashier of the bank did so. Then he wired the Lawson bank that the money had been shipped as requested. This message was intercepted by the two operators in the woods, and they changed the message so as to read as an order from the City National Bank to the Lawson Bank to deliver the $5,500 over to R. F. Reed, who would call for it by check. They then sent this message to Lawson. The president of the Lawson bank became suspicious and telephoned to Kansas City. He learned that the money had been shipped in response to an order from him, which was a forgery. When a man presented himself at the counter for the money, exhibiting a check for $5,500, he was promptly arrested, while a posse of citizens caught his accomplice later. The men were recognized as Robert O'Connor and Harry Turner, two operators who had been employed at Lawson for a short time.

Aerial Trolley Across the English Channel.

A New York daily a few days ago printed an illustrated article on a proposed aerial electric railway across the English Channel. The alleged inventor is "Count Bompio Pieri." The Count proposes to stretch two wire cables across the Straits of Dover and hold them aloft by means of captive balloons. One of the cables is to convey electric current to the motor of the car, which will move between the two cables, and the other will return the current. As pictured, the car is of the usual cigar shape. The terminal stations are also constructed on the balloon idea, captive balloons being used to convey the passengers from *terra firma* to the aerial trolley level.

Life-Saving at Sea.

The executors of the late Anthony Pollok, the well-known American patent attorney who, with his wife, was lost in the wreck of La Bourgogne, set aside a sum of $20,000 to be the award in a competition for the best life-saving device in case of disasters at sea. The matter was placed by the executors in the hands of the United States Government, which issued instructions to its representatives abroad to urge upon the governments to which they were accredited its cordial co-operation in furthering the object of the bequest. The authorities finally deputed the task of decision to the Directors of the Paris Exposition, whose action in rejecting every invention entered has been already announced by cable. By Rule 3 of the award, it was stated that should none of the inventions entered be of a sufficient value to entitle it to a prize, the jury might reject any or all of them, but, at the same time, should be empowered to indemnify competing inventors for the trouble to which they had been put. The 800 competitors are now besieging the United States Naval Attaché in Paris with complaints that the rules prescribed for the contest have not been lived up to. It is charged that, although an exhaustive examination had been promised to each invention submitted, the whole batch were disposed of in 20 hours, and that the jury went for their holidays before some of the exhibits were even unpacked. It is further alleged that the experts connected with the jury were not permitted to see a third of the exhibits, and that so far no action has been taken as to the question of indemnifying the unsuccessful competitors. The English marine engineers interested have drawn up a protest to the United States Naval Attaché, condemning the whole affair as a most "unbusinesslike and unsatisfactory" proceeding.

Highway Rights of Automobiles.

The first adjudication by a New York court defining the rights of the owner of an automobile and establishing the status of such a machine on a public highway was made in a recent decision by Justice Sutherland, of the County Court at Rochester. Suits had been brought in the Municipal Court for damages done by a horse which became frightened and ran away at the sight of an automobile on the street. Judgment was given in favor of the owner of the horse, the presumption being that the owner of the automobile was liable because his machine had frightened the animal.

On appeal Justice Sutherland reversed the judgment and declared the law on the subject as follows: "The horse has no paramount or exclusive right to the road, and the mere fact that a horse takes fright at some vehicle run by new and improved methods, and smashes things, does not give the injured party a cause of action. * * * If the defendant's motor carriage is practicable for the purpose of travel, and the noise and vapor caused by its use are kept within reasonable limitations, and are no greater than are fairly incident to the use of motor carriages which are found adapted to the needs of the general public, then I cannot see how the defendant can be held liable in the absence of evidence that at the particular time complained of the carriage was operated carelessly. The temporary inconvenience and dangers incident to the introduction of these modern and practical modes of travel upon the highway must be subordinate to the larger and permanent benefits to the general public resulting from the adoption of the improvements which science and inventive skill have perfected."

"Home Week" Celebration in Cleveland.

"Home Week" was celebrated in Cleveland a fortnight ago, the electrical features contributing largely to its success. Among the latter were the electrical displays on the principal streets and buildings. Superior Street, from Bond to the Viaduct, was decorated with arches of colored incandescent lights, the pillars for the arches being built around the trolley poles at intervals of 120 ft. Each pillar supported four arc lamps hung from arms. In the centre of the Public Square was an immense sign with the word "Welcome" in colored incandescent lights, and the 150-ft. flag pole in the centre of the square was festooned with incandescent lights. In these decorations, over 6000 Buckeye 16-cp lamps were used. Current was supplied free of charge during the week by the Cleveland City Railway Company and the Cleveland Electric Illuminating Company. The former furnished over 2000 incandescent lamps and the latter 4000 incandescents and about 100 arcs. The most striking and unique display was made by the Cleveland City Railway Company. One was the directors' private car, beautifully decorated with incandescent lamps. At the ends of the car were large signs bearing the words, "Cleveland's population, 381,768." The other attraction consisted of a marching club, composed largely of street railway men, of whom there were 125, each carrying an incandescent lamp. The lamps were connected in series of five, the main wires running around on the outside of the marching column and each man holding the wire. The current was obtained from the trolley wire by means of a long trolley pole, and the ground connection was made through the rails. The lights carried by the men were of different colors. At the head of the column was carried a sign bearing the words "C. C. R. R. Escort Club" in white incandescent lamps. This novel idea was devised by Mr. Fred Feld, one of the electricians of the company. The weeks was a record breaker in local street railway traffic. On Wednesday, which was the heaviest day, the Cleveland City Railway Company carried 160,000 people and took in $7,500 in cash fares; the Cleveland Electric Railway Company carried nearly 200,000 people and its receipts amounted to $9,500 in cash. The wiring and construction work for the street illumination was done by the Electrical Supply & Construction Company, in charge of Mr. E. S. Warner, superintendent.

CURRENT NEWS AND NOTES.

ROENTGEN SOCIETY.—The Roentgen Society of the United States has made a preliminary announcement of its regular meeting which will be held at the Academy of Medicine, 17 West Forty-third Street, New York, on Dec. 13 and 14 next. Dr. J. Rudis-Jicinsky, of Cedar Rapids, Ia., is secretary and treasurer of the society.

THE KENTUCKY'S TURRETS.—The new United States battleship Kentucky has some trouble with her superposed turrets and after starting from New York for China has put back. The turrets are said to be out of line, or the recoils too weak. They stuck so fast the electric motors could not move them after a discharge of the 13-in. guns in the lower turrets.

THE ALASKA CABLE.—A special dispatch from Seattle, Wash., of Oct. 19 says: "The Pacific Coast Steamship Company's steamer Orizaba, which was wrecked on Rocky Point Reef, St. Michael Island, on Sept. 17, while laying the Government telegraph cable between Nome and St. Michael, is a total loss. The vessel was abandoned Sept. 17, according to a dispatch received here. Ten days' constant effort to haul her off resulted in failure. Her crew and the cable and all the apparatus aboard the steamer were taken to St. Michael."

UNDERGROUND ROAD ACCIDENTS.—On the Central London electric underground road, an American car conductor was found dead on the track. He is believed to have been knocked off the train by a signal while trying to watch some obstreperous passengers. In Paris two of the trains collided on the underground at the Place de la Concorde Station, when 29 people were injured. There was a misunderstanding of signals. The lights were jarred out, and the consternation in the dark tunnel can be more easily imagined than described. Traffic was suspended for several hours.

THE TELEPHONE IN THE POLITICAL CAMPAIGN.—Campaign orators who speak in Bluffton, Ind., are meeting with a new experience in not knowing the number of their hearers. The political "spellbinders" make their speeches in the Circuit Court room where the United Telephone Company has placed on a table immediately in front of the speaker a receiver, with which connections can be made with a large number of telephones throughout the city and country. Farmers need not come to town to hear the speeches. Speeches of United States Senators and orators of note have been listened to by auditors miles away.

CHICAGO TELEPHONE RATES.—A special dispatch from Chicago of Oct. 22 says: The Chicago Telephone Company announced to-day its decision to reduce from 10 to 5 cents the rate of service for pay station telephones. The work of installing the new 5-cent slot telephones was also begun, and will be pushed to completion. The cut in the rate means an aggregate saving to patrons of $500,000 a year. It is also the purpose of the company to supply with a telephone every store or residence in Chicago which might assure a business of at least 5 cents a day, and it is expected that over 20,000 new pay telephones will be installed in this manner.

THE MORSE TABLET REPLACED.—The bronze tablet which was placed in the wall of the old building at 5 West Twenty-second Street, New York City, to mark the house in which Samuel F. B. Morse, the inventor, lived for many years and died, has been replaced in the new Spinning-Wheel Building, James McCutcheon, owner, erected on the site of the Morse house. The tablet bears the inscription: "In this house S. F. B. Morse lived for many years and died." Under it has been added: "This tablet removed from building formerly on this site and replaced A. D. 1900." The American Institute of Electrical Engineers tried to buy the house once, but the price set on it was far beyond its means.

NEW YORK ELECTRICAL SOCIETY.—The 208th meeting of the New York Electrical Society will be held at the College of the City of New York, Twenty-third Street and Lexington Avenue, on Tuesday, Oct. 30, at 8 p. m. The evening will be devoted to a symposium on the Paris Exposition and the Paris Electrical Congress. The subject will be profusely illustrated by lantern slides. Addresses on its various branches are expected from President Hering, of the American Institute of Electrical Engineers; Dr. A. E. Kennelly, Prof. F. B. Crocker, Mr. C. O. Mailloux, Mr. T. C. Martin and others who have visited the Exposition and participated in the congress. Members may be accompanied by ladies.

CARBIDE WORKS AT OTTAWA.—A Canadian correspondent states that the new building of the Ottawa Carbide Company, Ottawa, Ont., contains some of the finest machinery on the American continent. The plant is capable of producing sufficient carbide to supply a very large share of the needs of the world in this commodity. To describe the interior of the big building is at present impossible as no outsider is yet allowed within its walls for the reason that the machinery comprises, it is said, several valuable improvements which have not yet been patented, and new processes that are alone known to three or four principals. It is intended to run the works continuously, night and day, having three shifts of workmen, so that a very large output of carbide seems assured. The construction of these works is estimated to have cost over $500,000.

ELECTRIC SAFE BLOWING.—That safe blowing by electricity is not a safe or easy thing, as so often asserted, is shown by the following dispatch of Oct. 6 from Pomeroy, Ohio: A peculiar accident occurred at Middleport the other day and the full effects of it have just dawned upon the injured parties. The big iron safe in the Middleport shoe factory refused to open, and the book-keeper, Louis Jaquith, and Engineer Walter H. Rice conceived the idea that they could burn out the combination by use of carbon and electric wire. It took several hours to accomplish their purpose, but they finally succeeded, but not until they had stood for several hours in the glare of the electric light, taking turns at holding the wire and carbon. When the work was over both complained of a dizziness and pain in the head which increased as the hours passed, and in a short time both went suddenly blind at about the same time. All efforts to restore their sight have been unavailing, for while the eyeballs appear all right, the sight is destroyed.

A NOVEL ESCAPE.—Two desperate convicts at the Tennessee Penitentiary made a daring and novel escape from that institution at Nashville on a recent evening by sliding down two telephone wires from the top of a three-story building to a point outside of the high stone walls. Both worked in the harness department, and after roll-call managed to return to the building and gain the roof. They had provided themselves with two big pulleys and a wadding used in the manufacture of bridles. The convicts mounted two slender telephone wires, bicycle fashion, and on this took their coast to freedom, the men passing 15 ft. over the wall. The rattle of the wires attracted the attention of the other convicts, but not the guards, and it was some time before the escape was discovered. We are almost sorry to record that the men were caught. The maker of the wire ought to come forward and claim his "ad."

A METER ASSOCIATION.—Mr. Robert Ferris, of the Somerville Electric Light Company, Somerville, Mass., and Mr. Ben W. Clark, of the Edison Illuminating Company, of Detroit, Mich., met recently at Mr. Clark's office in Detroit for the purpose of organizing an association of meter experts, having as its object the advancement of the interests of electric light companies, with whom such experts may be connected; also the further practical benefit of each other. It is proposed that they meet annually and discuss such papers and topics as would be brought before them. It is hoped that the central station managers will appreciate a movement of this kind and lend it their hearty support. Central station managers, and meter experts, in particular, are invited to communicate with Mr. Clark, at Detroit, or Mr. Ferris, at Somerville, so that steps may be taken for immediate organization. Mr. Robert Ferris has lately been visiting Chicago in the interests of this new organization.

EGG INSPECTION.—It is stated that the local union of egg inspectors at Chicago is trying to effect a national organization. The men engaged in this business were formerly termed candlers, on account of using a candle to ascertain the condition of the egg, but the abandonment of that glimmering light and the application of modern appliances has made the name not altogether applicable, and that of egg inspector has been adopted as more appropriate. Thousands of dozens of eggs are inspected in Chicago daily by nearly 200 men. The inspector operates in total darkness and is able to ascertain the condition of the egg by the aid of an electric light, the globe of which is almost incased in tin, so that only a small ray of light shines on the egg. He must work with lightning-like rapidity in order to inspect the large number of eggs regarded as a fair day's work. Mishaps rarely occur, however, and so expert do the workmen become that thousands of eggs will pass through their hands without a shell being cracked.

NEW HAVEN'S ELMS.—The report of the special commission of citizens appointed to investigate the condition of the elm trees of the city has just been handed in. It shows that through various causes, as already noted in these columns, New Haven is rapidly losing the fine elms that have made the city famous, and that in a few years, unless something is done, the traditional City of Elms will be only a name. Hundreds of them are dying off each year now, and in windstorms are blown down. The commission reports that the trees are dying off for several causes, lack of plant food in the streets, mutilation of trees by horses in spite of special laws prohibiting the hitching of horses to trees, poisoning by illuminating gas leaking through the soil, and insects and elm-tree beetles that have been a pest there for several summers. The mayor is advised by the commission to spray the elm trees regularly with beetle-killing substances; to plant new and strong trees in place of the old ones, and to employ a skilled forester. The attempt to attribute the death of the trees to stray electric currents has failed signally.

HIGH POTENTIAL TROLLEY WORK.—Mr. W. B. Potter has taken out a patent and assigned it to the General Electric Company on trolley work with potentials far in excess of those now ordinarily used, and up to 5000 or 6000 volts. It has for its object to so arrange the parts of the trolley that any considerable leakage or short-circuit across the lines is rendered impossible; and to insulate the controlling cord of the trolley so that the conductor is not likely to receive a dangerous shock in wet weather. To effect the first purpose Mr. Potter insulates the trolley base from the car by porcelain insulators carried on supports so that the trolley base is entirely insulated. To effect the second purpose he insulates the cord from the trolley pole by a device made of substantial insulating material, such as porcelain or compressed asbestos. Although this will in itself form ordinarily a sufficient protection, he further safeguards the operator by forming this cord with a metallic core, which is grounded upon the truck frame of the locomotive and is surrounded with flexible insulation, a hempen cord being ordinarily sufficient.

JUNGFRAU ROAD.—In view of the fact that the electric three-phase road up to the Eigger Glacier is a great success, the following from the London *Graphic* should be received with caution: No one whose money has not been lost in the enterprise is likely to be overwhelmed with sorrow at the news that the building of the Jungfrau Railway has been abandoned because the cost turned out to be heavier than the engineers expected. Many mountain railways—those of Pilatus and the Rigi, for example—are defensible. They help the tourist to reach places, otherwise difficult of access, to which it is natural that he should want to go, and in which it is good for his health that he should stay. Railways up the great snow peaks belong to a different category, seeing that the tops of such mountains are places where no one can stay for much more than half an hour without feeling very ill, and that the quick transition from a hot valley

to a frozen summit and an atmosphere deficient in oxygen would be very injurious to any one with weak heart or lungs. The project, in short, had nothing to recommend it; while the conception was as Philistine as that sometimes mooted of a hydraulic lift to the top of the Pyramid of Cheops. The tears shed because it is relinquished will be few.

AUTOMOBILISM AT COLOGNE.—Mr. C. E. Barnes, United States Consul at Cologne, Germany, reports as follows: Cologne is the only city in this consular district in which the manufacture of vehicles is an industry of any importance. There are 15 what are termed "large factories" by the trade, and each of these makes from 20 to 70 horse vehicles yearly. The average last year was 45 vehicles per factory. Many small two-wheeled wagons or carts for hand use are also manufactured, as well as a number of dog wagons, 75 of these being made by each of the factories last year. Most of the horse vehicles are made to order; they consist principally of drays or transport wagons. Pleasure vehicles are imported principally from France and England. The total capital represented in this industry in Cologne is about $1,190,000. There is undoubtedly a market for American vehicles in this district, providing the same are manufactured to suit the trade. There are in all about 130 automobiles and motor wagons in use in the city of Cologne, and most of these were manufactured here. Police regulations require that all automobiles and motor wagons shall be registered. The speed at which they are allowed to run must in no case exceed 12 kilometers (7.4 miles) per hour.

A NEW METER.—Mr. W. M. Mordey and Mr. G. C. Fricker, of England, have been granted a patent in this country on an electric meter suitable for either alternate or direct currents. For this purpose there is used in conjunction with a dead-heat escapement, such as that employed in an ordinay timepiece movement, a suitably shaped soft iron piece "armature," preferably laminated, attached to the balance wheel or to the balance wheel arbor, and a coil or winding of wire, through which is passed the current to be measured, or a proportion of it shunted from a resistance. The armature is arranged to oscillate with the balance arbor, and the wire coil is mounted in such a position relatively to the armature that on the passage of a current through the coil the armature is magnetized and attracted toward the centre line or magnetic axis of the coil. When the armature is drawn toward the centre line of the coil, the momentum of the armature and its attached mountings, together with the action of the escapement, carries the armature past the said centre line toward the other extreme point of the stroke or throw, after which the magnetizing action of the coil draws the armature back toward the centre line, across which it is again impelled, as before. Thus, without any "make" or "break" of the electric circuit the armature is caused to oscillate to and fro across the centre line of the coil so long as the current flows and until the escapement runs down, the rate of oscillation being proportional to the current through a range sufficient for the desired purpose. The number of oscillations is recorded by counting gear. When no current is flowing the clockwork stops and the armature takes up a position of rest (under the control of the escapement) at or near one or other of the extreme positions of its stroke or throw. The escapement is arranged to impart its impulse to the balance wheel before the armature has reached the middle position of its stroke.

TELEPHONE CLEARING-OUT SIGNALS.—Mr. J. L. McQuarrie, of Chicago, has received a patent and assigned it to the Western Electric Company, on an arrangement of circuits for governing the conditions of use of the subscribers' lines and clearing-out signals; adapting the relay signalling apparatus now in ordinary use in connection with exchanges whose subscribers still work for a living on magnetos at their stations. In adapting the relay switchboards for use in connection with telephone lines having magneto calling generators great difficulty has been experienced in so arranging the relay mechanism that the lamps, which are necessarily delicate, would not prematurely destroyed. It has been heretofore proposed to provide a line relay having two helices upon a common core, one, the main line coil of high resistance, in ciruit with the telephone line through which current from the magneto generator could be passed to energize the core, while the second helix was included in series with the signal lamp, a pair of normally separated relay contacts, and a battery, the armature of the relay serving to close the local circuit at said relay contact upon the energization of the core. This arrangement is objectionable for the reason that upon the closure of the local circuit, current would be induced from the main line coil into the local circuit, whereby the lamp would be subjected to a current of highly excessive voltage, the lamp being thereby quickly burned out. Mr. McQuarrie's invention consists in a signalling appliance having two parallel circuits, in one of which is a helix of a relay, while in the other a signal, preferably a glow lamp, is included, a switch controlled by the relay being employed to open and close both parallel circuits, a proper source of current being associated with the relay switch for this purpose. The cord circuit is also associated with a signal appliance having generally the charateristics of the line signal apparatus. The appliance is especially intended, as said, for lines having magneto generators at the sub-stations, in which case the relay is provided with a second line helix.

LETTERS TO THE EDITORS.

Mistakes in the Rating of Electric Lamps.

To the Editors of Electrical World and Engineer:

SIRS:—After reading your editorial comments upon my paper before the Franklin Institute on "Mistakes in the Rating of Incandescent Lamps," an abstract of which you published in your issue of the 13th of October, I feel that I must make some reply to your criticism and explain more clearly than the abstract seems to have done the real purpose of the paper.

I had no intention of championing a tipless lamp. I am sure that for some purposes they have a real value, and they have a certain beauty which is lacking in lamps made with tips. In selecting types of filaments from my stock of lamps in order to make the tests upon which the paper was based I had only tipless bulbs enclosing filaments of the double coil type. At some point in the body of the paper I call attention to this and say that an allowance of about 10 per cent may be charged against this lamp for increase in tip candle power due to omission of the tip.

If the paper had been intended to bring out the differences in the mean spherical candle-power of different lamps I would have conducted my tests on another basis. In a table which you produce as Fig. 6 of the abstract it may be noticed that the *real* mean horizontal candle-power values vary considerably from 16. If the mean spherical candle-powers had been measured with each lamp giving an actual horizontal candle-power of 16, they would have differed so that the best (double coil filament) is nearly 12 per cent higher than the worst (single U-shaped filament), and over 11 per cent higher than the mean of all the real spherical candle-powers based on 16 candle-power real horizontal. This is evidently true without the necessity of experimental proof; for if one has two lamps, both of the same horizontal candle-power, that one must have the higher mean spherical candle-power which holds to higher values as the light flux toward the tip is measured, and the higher the tip candle-power, the higher the mean spherical candle-power must be. My table was made to show, among other things, the sort of departure from *real* horizontal candle-powers which arises from using standard methods of measurement.

It is my opinion, formed after a good deal of observation, that most buyers and users of so-called 16-cp lamps think that they are getting the same sort of candle-power distribution from their lamps as one would from a point source—uniform in all directions except behind the base—when they think of it at all. The portable photometers that have come into use so much recently are not arranged to reveal the error of such an idea and only serve to give standard measurements. If a vertical rating of candle-power were the standard method, this would be emphasized as the horizontal candle-power has been emphasized in the past; and people would take it for granted that the horizontal candle-power were all right. Indeed, the necessary educational process which would have to be gone through to introduce a new method of rating would teach lamp users the sort of ratio between vertical and horizontal candle-power to expect with each common form of filament and any new form in which an attempt was made to unduly reduce the horizontal candle-power or that out toward the base would be treated with suspicion until its true merits were determined. And just here I want to say that the relative exactness of mean horizontal candle-power measurements and tip (or end on) measurements is not at all as you suppose. I can say as the result of a great deal of personal experience in lamp measurement that one can return to a reading of end-on candle power over and over and without respect to which side of the lamp is uppermost, while it is a rather hard thing to repeat a reading on horizontal candle-power. Reason it out as you may, experience is the best teacher, here as elsewhere.

A tip measurement of candle-power, or, as I prefer to call it, a measurement of candle-power end on, gives only the candle-power in one of the many directions in which a lamp gives light. However, not only is this by far the most important direction, but the measurement gives a good idea of the candle-power (or better the illumination) to be procured from the lamp through the whole solid angle through which comes the light flux which in nearly all cases is the useful flux. A mean horizontal candle is defective because it gives no idea of what candle-power will be given in useful directions. To compare the value of a single end-on measurement with a single horizontal value of candle-power is all wrong, since the horizontal values vary greatly from point to point (see figures in article), while the end-on measurement has but one value.

I am very much interested to know that recent specifications for incandescent lamps have demanded an end-on measurement not less than 44 per cent of 16 candle-power. I believe in this thoroughly; only the thing must be reversed. A certain end-on candle-power and efficiency should be required with a certain minimum horizontal candle-power. How strange that 44 per cent of 16 candle-power should be just 7 candle-power and so *just* include the lamp with long curl anchored filament! I have seen some very important recent lamp specifications which were more bold and required an end-on candle-power not less than 10.

My letter is becoming too long to deal with the matter of reflectors and reflected light. Reflectors are good if the right light distribution can be procured in no other way. The very use of them is the best evidence that lamps are usually wrongly made. The lamp itself should supply the light distribution without a shade which most of them give now only when proper shades are used. I am putting together some results of determinations on lamps with reflectors which I hope may later find a little room in your columns. This matter of reflected light is one about which quite too much theorizing has been done.

ARTHUR J. ROWLAND.
DREXEL INSTITUTE, PHILADELPHIA, PA.

New Ratings for Incandescent Lamps.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of Oct. 13 there is published an abstract of a paper by Prof. A. J. Rowland, read before the Franklin Institute, and published in the October number of the *Franklin Institute Journal,* to which you give a rather detailed editorial discussion. Both the paper and the discussion seem very timely, as they serve to bring up many points, not only in regard to the photometry and commercial rating of electric lamps, but also in regard to the best methods of utilizing artificial light in the production of illumination. If the discussion had no other result than to bring out the fact that between the production of a certain total *quantity* of *light,* and securing the best attainable *illumination* from that light, there is as wide a difference as there is between the production of a given quantity of *heat,* and the proper *warming* and *ventilation* of a definite space by that same heat, it would serve a most valuable purpose indeed; for this important fact is only beginning to be recognized. The subject of photometry is still in a nebulous and hazy state, so far as the general public is concerned. Millions of dollars are expended annually for light, based upon measurements which are not understood at all by the layman, and for the most part misunderstood by the professional. Anything which will tend to clear up the subject should be welcomed by all.

The traditions of the luminous flame still dominate the commercial photometry and use of all the new light-sources, notwithstanding the radical differences between them. The rating of an incandescent electric lamp by its horizontal intensity alone, is an example of the application of gas flame methods to the electric light. So great is the prestige of this tradition that the demand for a more rational method calls out adverse criticism from many quarters. In order to better weigh the arguments for and against this method of rating, let us condense and arrange them, so as to get a more concise view. The arguments in favor of the present method of using only the horizontal intensity may be summed up in two propositions, viz:

1. A given intensity at the equator represents a larger *quantity* or flux of light than the same intensity at any other point.

2. To substitute a vertical, or tip measurement, "would be placing a premium not merely upon tipless globes, but also upon any artifice which would serve to reflect more light out at the tip, and less at the equator."

In favor of the vertical measurement it is claimed:

1. That in the large majority of cases the lamps are used tip downward, and more or less nearly directly over the objects to be illuminated, and therefore the light emitted from the tip end is really the only useful light.

2. That the efficiency of a light should really be measured by the amount of *useful* light produced.

3. That the vertical measurement would be much more simple to make, as it requires no spinning of the lamp.

The first argument in favor of the horizontal rating is, of course, the statement of a physical and mathematical fact which cannot be contradicted. This fact is offset by the equally indisputable fact given as the first argument in favor of the vertical measurement.

Of course, the total quantity, or flux of light, must not be lost sight of in adopting a method of rating; the aim should be to insist on a measurement that will insure as large a quantity as possible of this flux being thrown into the most useful areas. We must take exception to your statement that, "in practice, we have to deal not merely with the incandescent lamp, but with an incandescent lamp encircled with its shade." It is the lamp maker's business to produce, and the consumers' right to demand, that the lamp itself shall be so constructed as to give the best and most efficient illumination, without regard to any extraneous means that may be used to correct its faults. The use of any sort of shade or globe is a positive admission that the lamp itself is imperfect, or insufficient as a means of producing a satisfactory illumination. It admits of no argument to say that it is more economical to throw the light directly into the most useful directions than to depend upon reflecting or refracting the rays after they have been emitted; for reflection and refraction always mean more or less absorption and loss. The use of reflectors or refractors is justified only by the fact that the increase in *useful* light more than compensates for the loss in *total* light.

The second argument for the horizontal rating, it seems to me, could be applied with even more force to favor the vertical rating. That the horizontal rating now in use has put a premium on any device by which the horizontal intensity may be increased without regard to the vertical intensity, is plainly evinced in the forms of filaments now in most general use. Both the anchored loop and the double filament present a larger vertical area of luminous surface, with consequent higher horizontal intensity, than would a single or double coil filament of the same length. It is only human nature, and always to be expected, that the manufactures will seek to produce a lamp which will *show* the best by the tests applied to it. If but a single test is to be used, therefore, the one which will necessitate the best *general* results is the most valuable one. Now, it seems to us that this is the strongest point in favor of the vertical intensity over the mean horizontal, as a means of rating. The mechanical conditions in the making of lamps are such that it is impossible to produce a lamp giving high vertical intensity without its giving a sufficiently great horizontal intensity also. In fact, the most exaggerated type of lamp of this sort, in which the filament is not only double coiled, but the coils flattened horizontally, so as to give the largest possible horizontal area of luminous surface, gives a vertical intensity of 14.9 candle-power, with a horizontal intensity of 16.6 candle-power, a mean spherical candle-power of 16.1, and a mean (lower) hemispherical candle-power of 16.6. Such a lamp gives an almost uniform distribution of light about its luminous centre, and can therefore be used in any position with correspondingly little difference in the useful illumination produced. It must be admitted that such a lamp comes much nearer the ideal, for general use, than the lamp giving only 4 or 5 candle-power vertically. It is difficult to see how a filament could be shaped to further increase the vertical intensity, without departing radically from the present methods of lamp construction; so that if the vertical rating were adopted, it would be impossible for the makers to produce a practical commercial lamp which would have its horizontal intensity reduced to less than its vertical intensity.

The argument that the real efficiency of a lamp is measured by the *useful* illumination produced is certainly a strong one. The measurement of any light source in "mean spherical candle-power" or in total spherical candle-power, often leads to the most absurd practical results. The use of naked arc lamps for street lighting is a case in point. Such lights are popularly supposed to be of 2000 candle-power. Accordingly, it was assumed that streets would be brilliantly illuminated by placing arcs at wide intervals. As a result, owing to the peculiar distribution of their rays, and their excessive intrinsic brilliancy, or glare, the effect produced was often worse than no illumination at all. The actual illumination of the pavement by a Welsbach

gas lamp would be enormously overestimated if deduced theoretically from the spherical candle-power of the source, since only about 25 per cent of the light ever reaches the pavement. There is only one adequate method of stating the value of a light-source, and that is by giving the entire curve of vertical distribution. This shows its actual value for any given use, and also enables the user to devise or select intelligently the most suitable and efficient means for converting the light into useful illumination. This method is free from the obscurity and misunderstanding which attends the use of "spherical candle-power." In the case of incandescent lamps, the determination of this curve is a simple matter, only requiring a few more photometer readings, and some simple means of setting the lamp at the different angles. But, if only one measurement is to be made, the vertical, or " end on" measurement seems to have the best claims to recognition.

Any investigation of the photometry of modern light sources at once brings out the fact that, at best, they are all imperfect as producers of *illumination* and must have the assistance of enveloping globes or shades of some description. But, as Kipling would say, "that is another story."

E. L. ELLIOTT.

NEW YORK CITY.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compound Alternators.—KORDA.—An illustrated description of the compound three-phase alternators at the Paris Exposition, one designed by Hutin and Leblanc, and exhibited by Grammont, and another, designed by Boucherot and exhibited by Breguet. Both have the common property that no special efforts are made to diminish the armature reaction, but a constant voltage is obtained by means of special exciters; also, that in both exciters rotary magnetic fields are used. The exciter of Hutin and Leblanc was described in the ELEC. WORLD AND ENG. Aug. 18, page 242. In the Boucherot exciter a rotary magnetic field is used, like in the Hutin and Leblanc exciter, but while in the latter there are two rotary fields, in the Boucherot exciter

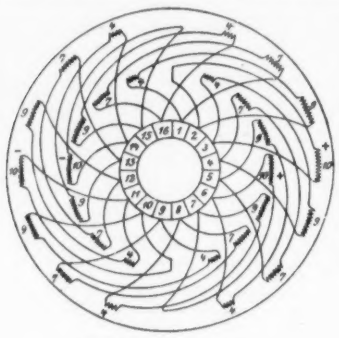


FIG. 1.—$k = 1$.

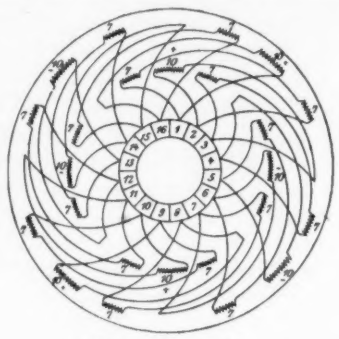


FIG. 2.—$k = -2$.

there is only one; the exciter field of both is produced by the combined effect of a shunt and a series three-phase current from the main generator. To get a direct current with a rotary magnetic field without the use of revolving brushes, Boucherot uses a direct current armature provided with an ordinary collector, but the winding of the armature is of a special form; it has not one, but two or three windings, and the number of the turns in each winding between two poles varies according to a sinusoidal law. With such an arrangement, and at certain speed of the armature, direct current can be taken off with stationary brushes, if there is a simple relation between the armature speed a and the field speed f, namely $f = k\ a$, where $k = 1, 2, .. 1/2, 1/3, .., -2, -3, \ldots$, and under the supposition that the two brushes form on the collector the angle $\pi / k + 1$. If n is the maximum number of turns on the sinusoidal winding and e a constant depending on the flux, the continuous voltage $2\ n\ e\ a$ is obtained between the brushes. The two most interesting cases are $k = 1$ and $k = -2$. When $k = 1$ the excitation can be produced with a single-phase alternating current, as a simple alternating field may be considered as the superposition of two rotary fields, one revolving with the same speed and in the same direction as the armature, the other with the same speed, but in the opposite direction; only the latter has any influence in this case. Fig. 1 is the diagram of such an armature for a two-pole machine. The case $k = -2$ is interesting as the exciter may have half the number of poles of the alternator; Fig. 2 is the diagram of such an armature; this is the one use in the machine exhibited. The alternator and exciter are directly driven by the same engine, the speed being 250 r. p. m.; the alternator has 24 poles, the exciter has 12 poles, and at a frequency of 50 it produces a rotary field with 500 r. p. m. In order that the voltage at the terminals of the alternator shall always have a constant value, independent of the load and the power factor, it is necessary and sufficient that the direct current, furnished by the exciter, vary according to a certain law, according to which the current is a certain function of the load and power factor. This is accomplished by the "compound transformer," the connections of which, with generator and exciter, are shown in Fig. 3, from which it will be seen that the three-phase current in the exciter field depends on both the voltage and the main current of the generator, therefore compounding the latter similarly to the action of the shunt and series coils in a direct current compound machine. —*Elek. Zeit.*, Oct. 4.

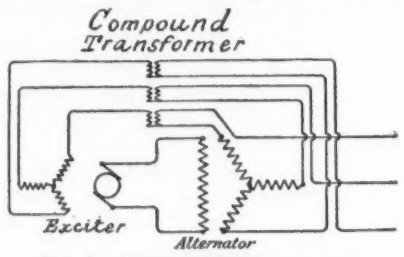


FIG. 3.—CONNECTIONS OF COMPOUND TRANSFORMER.

Dynamo Design.—CRAMP.—An illustrated article on "The tendency of modern dynamo design." Among the machines exhibited at Paris by makers of Continental Europe, there are signs of standardization very apparent in the matter of form, and to some extent of actual over-all dimensions and total weight. The tendency is to reduce the weight of the frame as far as possible; cast steel is almost universally used for the frames of all machines above about 5 kilowatts. In a discussion of direct current machines he says that few bipolars are exhibited; the four-pole machine is used for outputs as small as 2 kilowatts, and for motors even smaller. For almost all sizes the standard field frame is the circular shape with inwardly projecting radial poles. A division or partial division, of the frame at each pole is very common. Special devices for reducing sparking are almost entirely absent, and the only specialty of this kind is the laminated pole-tip with alternate long and short laminations. The ring armature seems to be a thing of the past. The alternators are all of the fly-wheel type, and in nearly all cases it is the field that revolves. A form of machine coming apparently just to the front is the "umbrella type," *i. e.*, a machine with revolving field magnets outside of the armature, but projecting radially inward from the extended fly-wheel rim. The shape of pole-face is universally rectangular, but its thickness varies from 5/8 in. up to 3 ins. (Kolben.) The form of the pole itself is usually rectangular, though sometimes round. Laminated pole faces are fairly usual, though not universal, and in some smaller machines the field magnets are laminated throughout. Most of the better known firms are building inductor type of alternators for special purposes, such as very high speeds, but they do not specially support or recommend them. There is a general feeling that plants of 1000 horse-power or 1500 horse-power are best running at a speed of about 90 to 100 r. p. m. —Lond. *Elec. Eng.*, Oct. 5.

Equivalent Air-Gap.—GUILBERT.—A mathematical article on "The apparent increase of the air-gap due to the use of slotted armature." Generally the equivalent air-gap is found by basing the calculation of the magnetic reluctance of the air-gap upon the hypothesis that the cross-section of the flux can be considered as constant over the whole air-gap and equal to the mean between the total pole face and the surface of the teeth; such a calculation, however, often gives too small values of the equivalent air-gap. He develops a more exact formula by assuming that all the lines of magnetic induction pass through the surface of the teeth and are uniformly distributed therein, by calcu-

lating the magnetic reluctances of the air between the furnace of a tooth and the portion of the pole face which coresponds to the sum of the length of a tooth and the distance between two teeth; both surfaces are supposed to be plane and parallel. The formulas thus obtained are applied to a practical example.—*L'Ind. Elec.*, Sept. 10.

REFERENCES.

Size of Brushes.—Dettmar.—An illustrated French translation of his long German article, abstracted in the Digest June 23.—*L'Ind. Elec.*, Sept. 10, 25.

Starting Induction Motors.—Deri.—In the abstract in the Digest, Oct. 13, on the third line from the bottom, "non-insulating" should read "insulating."

Lights and Lighting.

REFERENCES.

Behavior of Incandescent Lamps During Thunderstorms.—Taylor.—A communication referring to the phenomenon noticed in the Digest Sept. 22 and Oct. 13, 20. In view of Bose's recent work (E. W. & E., Oct. 13, p. 576), he accepts the coherer theory of the phenomenon.—Lond. *Elec.*, Oct. 5.

Power.

Transmission at Gold Mines.—E. K. Scott.—A summary of the principal points in a paper of Heather on the electric transmission plants at Moodie's Gold Mines, South Africa. Information is given on the actual results of working two rival systems, a direct current plant erected in 1893, and a three-phase alternating current plant erected in 1896. The chief difference is that the three-phase transmission line is worked at 10,000 volts, the direct current line at 3000 volts. The direct current system had a distributing station 4½ miles from the power station, in which were two motor generators, reducing the voltage to 625 volts. In the case of the three-phase system this distributing station was entirely done away with, the high tension line being in each case led near to the motors at the various mines, where transformers reduced the voltage to 190. Three-phase induction motors were found very suitable, with slip rings and a water resistance in the rotor circuit for starting. The original direct current compound wound motors gave a better starting effort, but, as it happened, the capability of starting was not of great importance, as almost all the machinery was required to run constantly day and night. The motor speeds, being dependent only on the frequency, remain practically constant as long as the generators run steadily. The taking off or switching on of any motor has no effect on the speed of any other motor, which is not the case with the direct current system. In the direct current plant the generator and motor generator frames were earthed; this is thought to have been a mistake; in the new three-phase plant the transformer frames are insulated from earth by about 6 ins. of timber; all the motors, with the exception of the one for the hoist, are on wood, and the main generators are placed on vulcanized fibre ¾ in. thick; it is noteworthy that the only breakdown of a three-phase transformer from lightning happened at the hoist, the low tension coils being connected to the only motor having an earthed frame. Some remarks are made on lightning arresters, lightning veing very prevalent in the district; he noticed that the telephone insulators broke down during a lightning storm much more frequently than the power insulators, which was found to be due to the thinness of the earthenware between the wire and the insulator bolt, this being only ¼ in. on the telephone insulators, as against ⅞ in. on the power insulators; the trouble was overcome by simply leaving the end of the bending wire long enough to be bent down and wound until its extremity came to within ⅛ in. of the insulator bolt; these short spark-gaps were fitted to about every tenth pole; the great value of the Siemens & Halske horned type arrester is pointed out. He gives a summary of the advantages of three-phase transmission, the most conspicuous of which is that the staff and the other expenses are reduced nearly one-half.—Lond. *Elec. Rev.*, Oct. 5.

Paderno-Milan.—An illustrated article on the water power station at Paderno on the river Adda, from where the current is transmitted to Milan over a distance of 20 miles for the purpose of running the tramways and the lighting of that city. Three-phase currents are generated at 13,500 volts without the use of step-up transformers. There are seven turbine-driven three-phase machines, each of 2160 horse-power, 13,500 volts, 42 periods, 180 revolutions. For the transmission to Milan there are in use six three-phase lines, or 18 wires in all, each being 0.35 in. in diameter. There is an intermediate transformer and auxiliary power station at the Porta Volta at the city boundary; it contains two 225-hp and three 1000-hp steam driven alternators, generating current at 3600 volts; also fourteen step-down 350-kw transformers, reducing the voltage from 12,000 to 3500. The real substation is at Santa Radegonda and contains four motor generators, each of 500 kilowatts, and 500 volts for the tramways, two of 250 kilowatts and two of 60 kilowatts for the three-wire lighting network at 110 volts; the dynamos are in each case driven by induction motors at 3500 volts.—Lond. *Elec. Rev.*, Oct. 5.

Electric Cranes.—Williams.—A paper, read before the Pittsburg Foundrymen's Ass'n, in which he gives practical hints regarding multimotor electric traveling cranes for foundry use. The main part deals with the mechanical features of the cranes. Nearly all the electrical troubles with cranes are said to arise from imperfect insulation, as fine dust and "flyings" are liable to settle anywhere and to cause a ground or short circuit. Wooden battens should be used to prevent the trolley from swinging against the girders, but wood alone should never be depended upon as an insulator. The practically perfect crane controller is said to be yet a matter of the future; all parts should be accessible and so arranged that those subject to wear can be removed and replaced with a minimum amount of trouble; the resistance coils should be arranged so that close control over the crane can be obtained, as without it delicate handling is impossible; the device by which the operating levers are centred, or held in the position at which the current is off, should be so positive that the operator is not likely to throw the lever too far and reverse unintentionally; any weakness in this device is a constant source of danger. He also gives some notes on the motors and the brakes.—*Eng. News*, Oct. 11.

Alternating Current Transmission and Distribution.—Leblanc.—The first part of a condensed illustrated translation of the second and third parts of a paper read before the Internat. Elec. Congress on "The transmission and distribution of energy by alternating currents." One part deals with the oscillatory movements which always tend to superpose themselves upon the rotary motion of alternators coupled in parallel, and with the suppression of these oscillatory movements by his amortisseur. The other part, of which only the beginning is given, deals with the properties of single-phase induction motors; when the primary is supplied with a current of constant effective strength, it can furnish mechanical energy or absorb it, according to the speed at which it is turned; in the latter case it in reality behaves as a generator.—Lond. *Elec. Rev.*, Oct. 5.

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Power Generation.—J. B. C. Kershaw.—The conclusion of the reprint in full of his paper (Digest, Oct. 6, 20); also the discussion which followed.—Lond. *Elec. Rev.*, Oct. 5.

Traction.

Polyphase Traction.—Bell.—An illustrated article on polyphase railway apparatus and methods. The first result of the demand for polyphase transmission for electric railways was the development of the large engine-driven polyphase generator. The design of a polyphase generator of one to several thousand kilowatts for direct connection to an engine was a serious one, one reason being the speed of revolution. Engines of 2000 to 3000 horsepower are built to run between 75 and 90 r. p. m., and while it is easy to design a large direct current generator for this speed, it was more difficult to build a polyphase generator on account of the large number of poles required. Hence the field magnet frames had to grow enormously larger than usual. The practice has become general to build these large generators with a stationary armature and a revolving field. He gives illustrations of two railway generators with details, also of transformers, high cost, the weight of the batteries, and the greater skill required from the attendants, were well known long before the system was introduced in Berlin. It is unfair to place the responsibility for the great delays and interruption of traffic on several days during last winter, on the storage batteries; the main causes were that the capacity of the batteries had not been chosen large enough and that very great variations of voltage occurred in the trolley line, between 400 and 600 volts, while the normal voltage is 500, so that the charging of synchronous converters and polyphase railway motors with their controller.—*St. R'y Jour.*, Oct. 13, and Int. Ed., Oct.

Storage Battery Tramway Cars in Berlin.—Zacharias.—An article commenting upon the news of the daily press that the storage battery cars running on several lines in Berlin are to be abandoned and that the trolley is to be used throughout, with the exception of only very short lengths of line, where for asthetical reasons the conduit system is to be used; it is proposed to abandon all storage battery cars before next winter. This decision is very severely criticized by the author,

who shows that the real disadvantages of the accumulator system, its the batteries could not be done properly. As there were no recording voltmeters in the cars, it has happened that at points of the line where the batteries were supposed to be charged, they were discharged and supplied current to the trolley line. The city of Hanover is mentioned as an example of a very successful accumulator car service; there, however, the system has been introduced from the first with the greatest care. The subject is also discussed editorially.—*Centralblatt fuer Accum. und Elem. kunde,* Oct. 1.

Automobile.—SOULIER.—An illustrated description of the Meynier and Legros electric automobile for four passengers, shown at the Paris Exposition. The weight is 2750 lbs.; it can run with one charge on a level road over a distance of 62 miles at an average speed of 14 to 16 miles per hour. The battery consists of 48 Fulmen cells. The motor has two independent ring armatures outside of the field. Four different speeds are obtained by series parallel control of the two halves of the battery, by series and parallel connection of the two armatures, and by shunting the series field for the highest speed.—*L'Ind. Elec.,* Sept. 10.

France—CONNETT.—An article on electric railway practice in France. Practically all tramways in France outside of Toulouse and Paris are now operated mechanically, most of them by the trolley system. He gives illustrations of the principal forms of track construction, switches and overhead construction, and describes the procedure of securing a franchise in Paris. The limiting drop in voltage on the rail when used as a return curent is 1 volt per kilometer. Some typical cars are illustrated.—*St. R'y Jour.,* Oct. 13, and Int. Ed., Oct.

Kansas City.—An illustrated article on the street railway situation in the two Kansas Cities. The most notable feature of the city is its extremely regular profile. The lines of the principal tramway companies have an aggregate length of 160 miles of track, of which 120 miles are operated electrically, the remaining 40 miles being cable driven, which, however are being changed over to the electric systm. There is also a separate table showing the detailed cost of operating one of the power station in Kansas City; the cost per kilowatt-hour was from 0.544 to 0.331 cents.—*St. R'y Jour.,* Oct. 13, and Int. Ed., Oct.

REFERENCES.

Electric Locomotives in Railway Yards.—LOCH.—A report on the working costs of a standard gauge electric locomotive, made by the Gen. Elec. Co., of Berlin, and used for shunting operations in the railway yard at Gleiwitz, Germany. The locomotive is described and the results of some tests are given; also information about the costs of installation and operation. It appears that the electric service is by far the cheapest and that a saving of over 40 per cent in favor of the electric service has been effected.—Lond. *Elec. Eng.,* Oct. 5.

New York.—VREELAND.—An illustrated article, giving some information about the speed, number of cars and passengers, and the construction of the cars, of the surface lines in New York proper. Also an illustrated description, by Millen, of the standard cars of the Metropolitan Street Railway Co. Also a separate large table, giving the receipts and detailed operating expenses of the Metropolitan Street Railway Company for the three years ending June 30, 1898, 1899 and 1900; the figures are also given per car-mile, for cable, electricity and horses.—*St. R'y Jour.,* Oct. 13, and Int. Ed., Oct.

Rio de Janeiro.—An article on the street railways of Rio de Janeiro. There are five tramway companies, but only the two smallest lines and 3½ miles of one of the large lines are electrically equipped, the others being operated by mules.—*St. R'y Jour.* Oct. 13, and Int. Ed., Oct.

Tramway Finance.—CLARK.—An article giving statistical data about American methods of tramway finance, compared with European methods—*St. Ry Jour.,* Oct. 13, and Int. Ed., Oct.

London.—An article giving a comparison of the speed obtained on the various London underground lines, whether driven electrically or by steam; the information is given in several tables.—Lond. *Elec. Eng.,* Oct. 5.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

REFERENCES.

Switch Gears.—WARRILOW.—A continuation of his long, illustrated serial on the evolution of switch gears for high pressure alternating currents, continuing the description of Ferranti switch gears.—Lond. *Elec. Eng.,* Oct. 5.

WIRES, WIRING AND CONDUITS.

Deterioration of Cables.—RHEINS.—A paper in which he states that when a cable is traversed by a current always in the same direction, it passes through four stages marked by the complete loss of some electric property, and a change in the remaining properties. The order of disappearance is the following: Inductance, capacity, insulation, conductivity. This process of deterioration is claimed to be due to the slow penetration of the metal of the core into the dielectric, and this penetration appears to be independent of the kind of dielectric, since it is observed both in the case of paper and of gutta-percha. In a gutta-percha cable, used for 20 years, the copper of the core had soaked through to the surface of the insulator. In a paper cable in use for four years, the copper had penetrated into the first layer of paper, but not into the second.—*Comptes Rendus,* Sept. 10; abstracted in Lond. *Elec.* Oct. 5. In an editorial note in the latter journal it is regretted that the author omits from his paper all reference to the details of the experiments, and it is urged that when they have been given the true cause of the effect ought to be investigated.

REFERENCES.

Heating of Electric Cables.—HERZOG and FELDMANN.—In the abstract in the Digest, Oct. 13, 21st line, 2 mm^2 x mm^2 cross-section should read 2 x 10 mm^2 cross-section.

ELECTRO-PHYSICS AND MAGNETISM.

Electric and Thermal Conductivities.—GRUENEISEN.—An account of an investigation of the influence which certain impurities in copper and iron have upon the ratio of thermal and electrical conductivities. In copper a very small proportion of arsenic suffices to reduce the thermal conductivity to one-tenth of its value in pure copper, while the electrical conductivity is reduced to one-twelfth of its original value; in iron the difference is even greater. In view of the theory of electrons it would seem that "the electrons conveying electric charges are evidently more disturbed by foreign bodies than those which convey heat only."—*Ann. der Physik.,* No. 9; abstracted in Lond. *Elec.,* Oct. 5.

Resistance of Busmuth.—EICHHORN.—An account of experiments in which he investigated the speed with which bismuth assumes a certain resistance under the influence of a magnetic field, and with which it loses it when the field is withdrawn. He mounted a bismuth coil on a revolving disk so that at a certain point it passed through a magnetic field; he measured the instantaneous resistance and compared the resistances shown at various points when entering or leaving the field, with the least resistances shown at the same points in a state of rest. A well marked difference was observed both on entering and leaving the field; on leaving the field the resistance remains too high. The difference is constant for any speed of revolution exceeding 500 per minute, but below that rate it increases with the speed. He calls the phemonemon a viscous hysteresis of resistance.—*Ann. der Physik.,* No. 9; abstracted in Lond. *Elec.,* Oct. 5.

Absorption of Hertzian Rays.—A note on experiments made by Guarino and Poncelet with a Wimshurst machine and a coherer, a few meters apart. The Wimshurst machine was provided with the usual condensers and emitted Hertzian waves which affected the coherer. When a screen was placed between the coherer and the machine, the former was protected. The human body, interposed between the machine and coherer, absorbed the rays, whether it was insulated or not. A thin sheet of iron, which did not screen the coherer under normal conditions, screened it when connected to earth. A hypothesis which they give for explanation is briefly noticed and criticized.—Lond. *Elec.,* Oct. 5.

Magnetic Properties of Iron Filings as Affected by Ferro-Manganese.—WILSON.—An account of experiments in which he studied the magnetic properties of a mechanical mixture of iron filings and ferro-manganese, compared with the magnetic properties of simple iron filings; he also studied the effect produced by high temperatures. The results are given in a series of diagrams. The presence of 17 per cent by weight of ferro-manganese reduces the dissipation of energy due to magnetic hysteresis for given limits in the values of either B or H, after being raised to a temperature of 800 to 900 degs. C. The increase in permeability after heating simple iron filings to about 900 degs. C. is greatly reduced by the presence of ferro-manganese.—Lond. *Elec.,* Oct. 5.

REFERENCES.

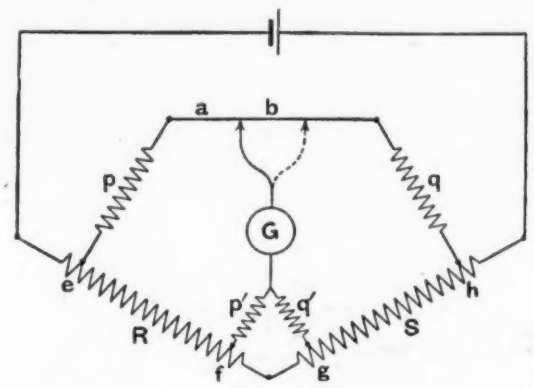
Atmospheric Potential During a Solar Eclipse.—An account of measurements made during a solar eclipse in Pavia, in order to examine the hypothesis of Elster and Geitel that a distribution of positive and negative charges in the atmosphere is due to an ionization produced by the impact of the ultra-violet rays of the sun upon the upper strata of the atmosphere. The results do not appear to be conclusive. —*Rendic. Ist. Lombardo.,* 33, 1900; abstracted in Lond. *Elec.,* Oct. 5.

ElectroChemistry and Batteries.

Electrolytic Analysis.—An abstract of the principal points of a committee's report to the Brit. Ass'n on electrolytic methods in quantitative analysis. Bismuth can be determined electrolytically with accuracy in simple and dilute solutions containing citric acid and even relatively large proportions of free nitric and sulphuric acids; but its electrolytic separation from any of the metals with which the committee have experimented cannot be recommended. In all cases in which the determination of very small quantities of iron in organic products is concerned, the exceptional delicacy of the electrolytic method, its freedom from the sources of error that arise with other methods on account of the inherent presence of salts and of organic matter, and finally the ready check on the nature and amount of the deposited metal, render it capable of giving reliable and comparable results under all conditions.—Lond. *Elec. Rev.,* Oct. 5.

Units, Measurements and Instruments.

Comparing Resistances.—Drysdale.—An article, illustrated by diagrams. He first describes the ordinary Carey-Foster method of comparing resistances, and then a modification of this method in which the slide wire is removed from its ordinary position between the resistance to be tested and the standard coil and is introduced between the ordinary ratio coils; this arrangement has certain advantages. The Carey-Foster method may also be used for very low resistances—



COMPARING RESISTANCES.

down to one ten-thousandth of an ohm—by applying the principle of the Kelvin double bridge, *i. e.,* employing a second pair of ratio coils p' and q', connected across the junction between the resistance R to be tested and the standard coil S, as shown in the adjoining figure. He shows how in this way the Nalder form of the Carey-Foster bridge can be easily modified to admit of low resistance comparison and describes in detail a new form of a universal Carey-Foster bridge, designed by Hughson.—Lond. *Elec.,* Oct. 5.

Measuring the Resistance of Cables—Heap.—An illustrated article describing a suitable method for testing the resistance of finished cables. The method consists in balancing the drop of potential produced in a slide wire by a constant current first against that over a standard resistance, and then over the unknown resistance, while the unknown resistance and this standard are permanently connected in series in another circuit in which a constant current is maintained; the drop of potential over the unknown resistance and that over the standard are measured on the slide wire, and the ratio of the resistances is then equal to the ratio of the slide wire lengths. The instruments required and the arrangement of the test are described in detail.—Lond. *Elec. Rev., Oct.* 5.

Telegraphy Telephony and Signals.

Sine Wave Transmission on Submarine Cables.—A long and interesting editorial discussing the system of Crehore and Squier (see their recent A. I. E. E. paper; also E. W. & E., Sept. 29, p. 481), from the point of view of the British cable engineers. It is said that their formulæ for calculating the impedance of the various parts of the circuit may prove of service and should result in improvements being made in the proper proportioning of the apparatus to the cables they are meant to work; there is room for progress especially in the design of the receiver, as it is highly probably that the best definition of signals will be obtained, other things being equal, when the receiving condensers, resistances and instruments in circuit are correctly tuned to the frequency of the arriving waves, and the formula may assist toward this by enabling one to calculate what the impedance at the receiving end should be to satisfy the conditions under which the waves are being propagated. The only true method of comparing the relative speeds of cables differing either in design or length, lies in the comparison of the frequencies at which impressed sine waves produce records of standard amplitudes at the distant ends of the cables; but for these comparisons a recording instrument ought to be used, having no appreciable electromagnetic or mechanical inertia, so that of itself it does not influence the results. This influence of the receiver was not considered by Crehore and Squier; their receiver was of the ordinary form and its adjustment remained unaltered throughout the experiments. "There is a disposition therefore to regard the results they obtained rather as measurements of the sensibility of the instrument to the amplitude and frequency of the impressed waves than of the speed capacities of the cables in question; in other words, the dying-away of discernible signals at the frequency of about seven complete waves per second, whatever the voltage employed, is attributable more to the want of synchronism between the coil of the receiving apparatus and the frequencies than to the reduction of the amplitudes occasioned by loss of energy along the cables." It is said that a large amount of patient experiment has been done in Great Britain and that "amongst other things, nearly every conclusion come to by Messrs. Crehore and Squier, as the result of their investigations and experiments, has been anticipated," such as the improvement in the received signals as the result of modifying the impressed wave form and increasing the e. m. f. and the influence of the composition of the signals upon the speed at which they can be transmitted. But the methods of experimenting were entirely different. It has been ascertained that by adding a certain resistance to the battery circuit, a condenser being used, and at the same time raising the voltage, a remarkable increase in the amplitude of the received signals is produced. This is explained as follows: "The effect of the inserted resistance is to retard the rise of potential in the condenser, and to cause the current flow to extend over a larger portion of the total period of the battery contact, and since the maximum height of the pressure curve is at the same time maintained by proportionately increasing the e. m. f., the total energy imparted to the cable is appreciably increased and the amplitude of the signals at the further end is consequently enlarged." The combined effect of condenser and resistance is to cause the front at least of the impressed wave to assume an approximately sine wave form. Between the signals the condenser is not earthed through the resistance, but directly; this does not destroy the resemblance to the sine wave. It is said to be possible that the sine wave theory may eventually be found not to fit the problem so completely as has been supposed, and that the "tuned condenser method" may prove by its flexibility to admit of a closer adjustment of the conditions at the sending end to the requirements of the cables and receiving apparatus. The sine wave transmitter has, however, theory to commend it and has also two chief advantages: Freedom from delicate mechanism and from sparking. It "also brings us one step nearer to the possession of signalling apparatus designed upon engineering rather than watchmaking lines."—Lond. *Elec.,* Oct. 3.

Duplex Wireless Telegraphy.—A reprint of, and some editorial notes on, a letter sent by J. A. Fleming to the London *Times.* Although he gives no technical particulars, he distinctly says that Marconi has recently succeeded in modifying his receiving and transmitting appliances "so that they will only respond to each other when properly tuned to sympathy." Experiments have been conducted between two stations 30 miles apart. In one of these he placed two receivers at one station, "one on the top of the other, and connected them both to one and the same wire, about 40 ft. in length, attached to a mast"; two messages, one in English and one in French, were sent from St. Catherine's at the same time and received properly by the two receivers. He also briefly states that Marconi has succeeded in replacing the vertical wire by a metal cylinder.—Lond. *Elec.,* Oct. 5; Fleming's letter is reprinted also in Lond. *Elec. Eng.,* Oct. 5.

References.

Telegraphy.—Camp.—An illustrated reprint of his Can. Elec. Ass'n paper on the use of the dynamo and storage battery in telegraph offices, noticed in the Digest Oct. 6.—*El'ty,* Oct. 10.

Statistical.—Some statistical data on the work of the International Bureau of Telegraphic Administration in Berne; also a continuation of the article on telegraphy and telephony in Switzerland during 1899; also an article on telephony in the United States at the end of 1899.—*Jour. Teleg.,* Sept. 25.

Radio-Telephony.—A note on experiments made by Prof. Popoff, of Kronstadt, Russia, with radio-telephony and wireless telegraphy.—Lond. *Elec. Eng.*, Sept. 28.

Telegraphone.—An illustrated article on Poulsen's instrument and its different applications.—*West. Elect.*, Oct. 6.

MISCELLANEOUS.

REFERENCES.

Electric Furnaces.—KELLER.—An English translation in abstract, with some editorial notes, of the French paper read before the Internat. Elec. Congress and abstracted in the ELEC. WORLD AND ENG. Sept. 15, pp. 412, 400.—Lond. *Elec.*, Sept. 28.

Similarity of Effect of Electrical Stimulus on Inorganic and Living Substances.—BOSE.—An illustrated reprint in full of his British Ass'n paper, an abstract of which was given in the E. W. and E. Oct. 13, p. 576.—Lond. *Elec.*, Sept. 14, 28, Oct. 5.

Production of High Temperatures.—LANGE.—An abstract of a paper read before the Iron and Steel Institute in Paris on the Goldschmidt process, which has been described and referred to repeatedly in the Digest.—Lond. *Elec. Eng.*, Oct. 5.

Screw Gauge.—The first part of a reprint in full of a committee report to the Brit. Ass'n on a modification of the small screw gauge.—Lond. *Elec. Rev.*, Oct. 5.

Metal Market.—Diagrams showing the fluctuations of the price of zinc, lead, iron, tin and copper during the month of September.—Lond. *Elec. Rev.*, Oct. 5.

Biographical.—An account of the life of the late Abdank-Abakanowicz, written by Claude—*L'Ind. Elec.*, Sept. 10.

Paris Exposition.—The eighth part of the illustrated serial, dealing with the Boucherot compound alternator (see Digest abstract under "Compound Alternators") and other alternators of French make.—Lond. *Elec.*, Oct. 5.

A brief illustrated description of a 1200-kw three-phase alternator of Ganz & Co. The voltage is 2200, the frequency 50, the number of poles 48; it is driven by an engine at 125 r. p. m.—Lond. *Elec. Rev.*, Oct. 5.

New Book.

LA THÉORIE DE MAXWELL ET LES OSCILLATIONS HERTZIENNES (Maxwell's Theory and Hertzian Oscillations), Scientia series. By H. Poincaré. Georges Carré and C. Naud, editors. 3 rue Racine, Paris, France. 80 pages, 5 illustrations. Price, 2 francs.

This little book forms one of a set of ten small volumes forming a "Physico-Mathematical Series," published in the French language under the direction of Appell, Cornu, D'Arsonval, Friedel, Lippmann, Moissan, Poincaré and Potier. It is divided into twelve chapters, which treat of the matter in the order of its historical development. The book is intended as a scientific exposition of the theory of Hertzian waves, without mathematics. In this the author has succeeded excellently, and none are better qualified than Poincaré to deal with so intricate a subject. His discussion of the vexed question as to whether the waves emitted by a Hertzian radiator are multiperiodic is attractive and masterly. Unfortunately, however, the book is so small that there seems to have been but little space allowed for illustrations, and the text is sometimes difficult to follow for want of a few sketches. To those who are interested in the theory of electromagnetic waves as distinguished from the practice of wireless telegraphy, this little handbook will be very interesting. It is worthy of being translated into English.

A New Type of Dynamo.

The Ball Electric Company, New York, has just completed the manufacture of a novel dynamo for special low amperage circuits. The machine is built on the well-known lines of this company's apparatus and will supply 50 lamps of 80 volts each. The feature of the dynamo, however, is the fact that it regulates perfectly on 2¾ amperes and is therefore capable of supplying lamps requiring but little current. In a test made recently at the Ball factory in our presence, the dynamo ran a circuit containing fifty 800-cp lamps, the engine which drove it requiring but 16 horse-power, or a little over three m., and the total rise in temperature at the hottest point but 58 degs. lamps per horse-power. The speed of the armature was 1400 r. p. F. above that of the atmosphere.

The Factory Equipment of the Kellogg Switchboard & Supply Company.

The new factory of the Kellogg Switchboard & Supply Company at Chicago is of more than usual interest, both on account of the importance of this company's work in the independent telephone field at the present time and because of the modern methods there employed. The company, when it first started in business in 1897, occupied the factory of the old Gray Electric Company, at Highland Park, Ill. In July, 1899, this was outgrown, and the plant moved into Chicago to the corner of Congress and Green Streets, where the factory has been rapidly enlarged and changed until it now occupies four floors of a factory 125 ft. x 75 ft., as well as a single-story building adjoining, of the same dimensions. The working capital of the company is now $400,000. One of the most noticeable and modern features of the new factory is the extensive use made of electricity, not only for light and heavy power, but for heating soldering irons and running small motors for various purposes. The heavy machinery is driven by one or two motors on each floor, and there are many small motors for winding and measuring appliances in addition. The power for the factory is generated in an adjoining building and the current is conducted direct to a fine distribution switchboard on the main floor of the Kellogg factory. From this board there are led three classes of circuits; one for power, one for light and one for heating soldering irons. The soldering iron circuits are provided with a pilot lamp at the main switch which shows to the night watchman whether the circuits are on or not, so that the heating circuit will never be

FIG. I.—ASSEMBLING RECEIVERS AND DESK SETS.

accidentally left on at night to waste current. An average of about 75 electric soldering irons is in use, though this is sometimes increased by a large per cent. The American Electrical Heater Company's irons are used. The electric soldering iron is, of course, ideal for work in a telephone factory, where the work is minute and so many irons are required. To heat the irons by any other method would mean a loss of time, and much greater fire risk, as well as larger bench space to accommodate the heaters. With the electric iron the heat is steady and certain, and a workman can do much more in an hour than if bothering to heat irons and clean them after each heating, to say nothing of the superior quality of work due to the steady heat. The irons used take 9-10 ampere at 110 volts. The factory is wired on a 110-volt three-wire system. The switchboard has a capacity of 500 amperes and has five Thomson recording wattmeters, a Jewell ammeter and voltmeter, and D. & W. enclosed fuses in the main circuit. The Edison Company furnishes current at night and whenever the adjoining plant is not run. The Edison Company has meters for both light and power and maximum demand. The other service is measured by two meters. The enclosed fuse is used all over the board, each circuit having its knife switch and fuse. There are about 1000 incandescent lamps and 90 horse-power in large motors, of which there are three 5 horse-power made by Roth Brothers, the others being Crocker-Wheeler of 10 to 20 horse-power. There are also eight small motors and twelve Western Electric Petite arc lamps.

The most recently completed department of the factory, and one in which the company takes special pride, as it is the only one of the kind to be found in an independent telephone factory, is the department for insulating its own magnet wires and switchboard cables. The company was forced to the establishment of this department be-

cause its orders were of such size the established manufacturers could not fill them promptly enough. This department can turn out 8000 ft. of 21-pair cable a day, which is hardly enough, however, to entirely supply the factory. It now comprises 12 machines for wire covering, 9 for cable covering, 2 for pairing wires for cables, 1 for forming cable from the pairs, capable of twisting a 60-pair cable, and 1 machine for winding silk onto spools for use in the machines. All cable is run through a measuring machine driven by a 1-10-hp Holtzer-Cabot motor. There is also a machine for bunching cotton thread for wire winding. The switchboard cables, after being run through beeswax, have the surplus wax melted off by being also run through a die heated by two electric soldering irons. This method is original with this factory.

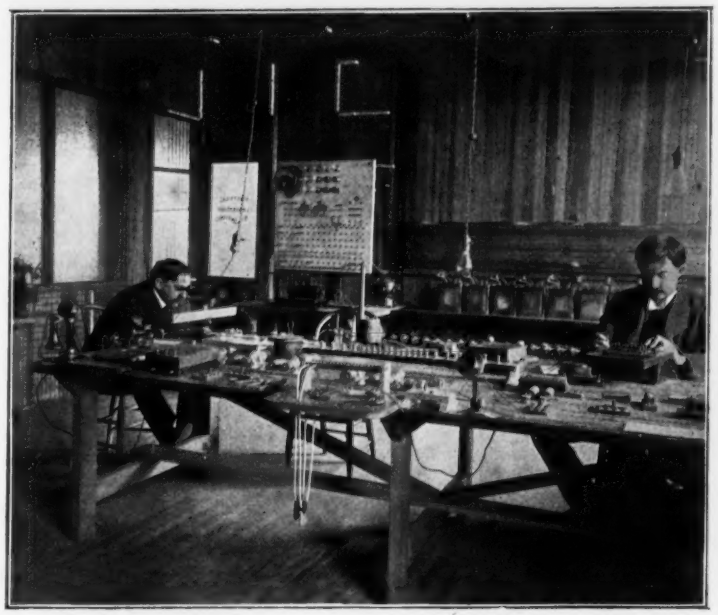


FIG. 2.—LABORATORY.

The work of the factory is divided into about thirty departments, each in charge of an expert and responsible foreman. It will be seen from the following list of departments how complete is the equipment: Engineering, drafting, experimental, laboratory, toolmakers, pattern shop, cabinet shop, foundry, blacksmith and annealing, punch press, milling, screw machine, drilling, coil winding, plating, lacquering and painting, receiver and desk stand assembling, spring jack assembling, relay assembling, transmitter assembling, subscriber's box, jobbing, switchboard frame, power switchboard, switchboard assembling, switchboard wiring, testing and inspection, and shipping. In the switchboard and spring jack wiring, the advantages of electric soldering irons are most apparent. The solder for this work is made up in the form of a thin rolled tube with a resinous flux inside the tube, so that there is no time wasted in handling flux.

A feature peculiar to this factory is the method of taking care of the hard-rubber shavings coming from the drill presses and automatic screw machines. An exhaust pipe is put over every machine working hard rubber and the shavings are sucked up, and being thus thoroughly clean, they are carried by the exhaust current of air to a common centre, where they are caught and can be taken out and stored away until the time arrives to sell them.

A photographic record of the output is kept for convenient reference. Every switchboard as it goes out is photographed in enough ways to show its construction, and the photographs constitute an accurate and convenient memorandum of the type of equipment sent to various cities.

FIG. 4.—TOOL ROOM.

The company was financed by and is under the direction of Milo G. Kellogg, its president. The prominence of the engineering staff in the immediate management of the business is one of the noticeable and creditable features of this company. Mr. Francis W. Dunbar, formerly of the Bell interests, is at the head of the engineering staff. Mr. Kempster B. Miller, the engineer in charge of manufacturing, is too well known to need introduction, having always been prominent in the independent telephone field. F. J. Dommerque, formerly of the Chicago Telephone Company, is engineer in charge of outside construction. The factory is under the immediate charge of W. M. Goodridge.

FIG. 3.—ASSEMBLING MULTIPLE CABLES—ELECTRIC SOLDERING IRONS.

Exhibits at the Street Railway Convention.

In our report last week of the Kansas City Convention of the American Street Railway Association, notes were given of a large number of the exhibits shown in the building known as Convention Hall. We are now able to present our readers with two general views of the display, embracing, in particular, the exhibits of the

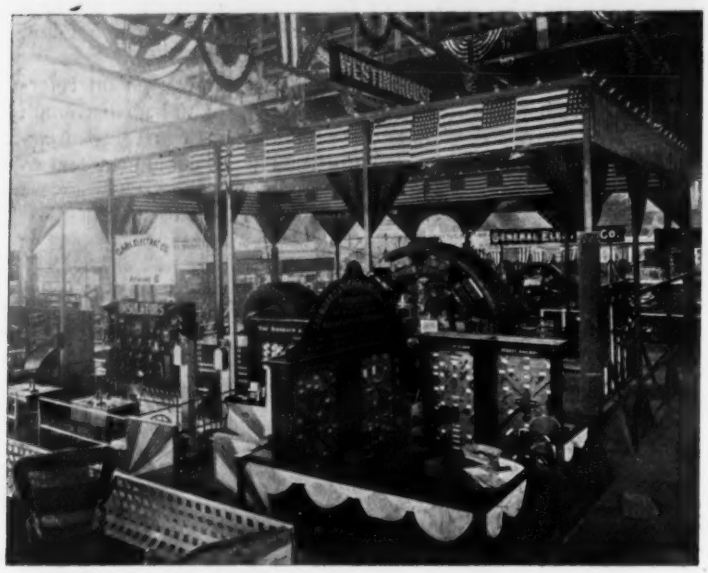


FIG. 1.—GENERAL VIEW OF EXHIBITS.

General Electric Company and the Westinghouse Electric and Manufacturing Company, but giving an excellent survey of the environment of these, the two largest exhibits. On the whole, it may be said that more money and taste than usual were expended on the exhibits this year, the various manufacturers still finding it to their interest to present their latest and best products before so large a gathering

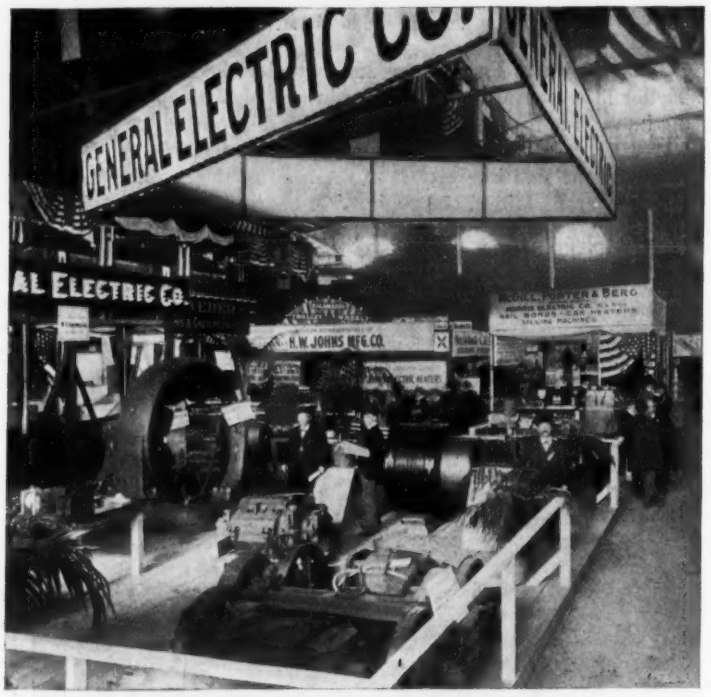


FIG. 2.—GENERAL VIEW OF EXHIBITS.

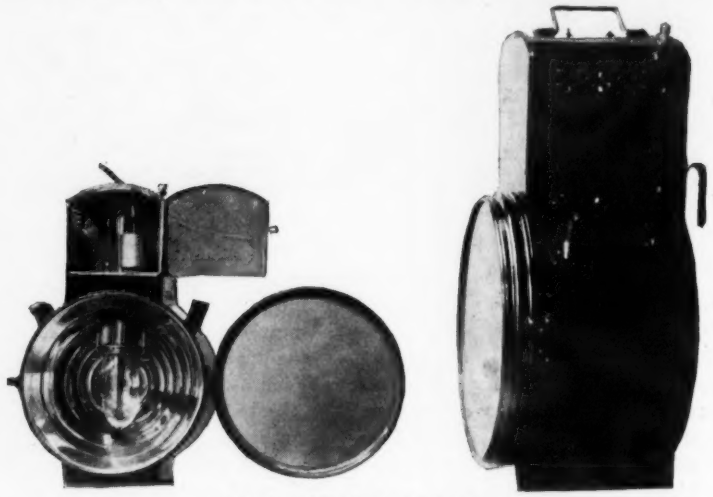
of their constituents. Details of electrical exhibits were given, as noted above, in our last issue. It should be added that Mr. John T. McRoy had a neat and interesting display of his terra cotta conduits which have already entered so largely into street railway construction.

Miniature Enclosed Arc Lamps.

The Lea Electric Manufacturing Company, of Elwood, Ind., in response to a demand from the trade for a lamp smaller than the ordinary 110-volt lamp and to burn only 2½ or 3 amperes, has brought out the miniature enclosed arc lamp, shown by the accompanying cuts. This lamp is constructed along the lines of the new type lamps this company is bringing out. The body of the lamp is a light, one-piece casting, galvanized by a special process which prevents rusting and gives it a very clean and finished appearance. The mechanism of the lamp consists of a solenoid with an iron-clad armature which operates a lever. Connected to the other end of the lever are the dash pot and clutch rod. A peculiar feature of the lamp is the fact that the upper carbon is completely enclosed and air-tight, there being no means for the entrance of air into the inner globe around the upper carbon, as in most lamps. The inner globe being closed at the bottom, the only chance for the entrance of air is over its upper edge, between it and the seat. The clutch is a plain ring clutch, readily accessible. The resistance is wound upon a grooved, porcelain piece. Contact with it is made by a sliding band tightened by one screw. The ready adjustment of the lamp is one of its most attractive features. The resistance may be altered by loosening one screw and slipping up or down, as may be required, the contact band. The current may be altered by slipping in or out upon the end of the lever a lead weight which is secured by a set screw. The current may also be adjusted by changing the relative position of the armature. This is done by loosening a lock nut and shortening or lengthening the armature link by revolving the armature.

The cover has been so designed that it will slip down and entirely off without removing the inner globe. This is done by simply raising the cover a little and turning it out of the bayonet catch which secures it in place. When doing this the shade or outer globe need not be removed from the cover unless desired. Both shade and outer globe are supplied with a spun globe ring which is locked into the cover by a single pivot catch, making one of the simplest globe-holding devices on the market.

The efficiency of the lamp and steadiness of the arc are assured by



SMALL ENCLOSED ARC LAMP.

using a carbon only 5-16 of an inch in diameter, while long life is secured by the peculiar construction of the body, as heretofore described. These lamps give a very high efficiency and are useful in replacing clusters of incandescent lamps and as a means for competing with gas and other illuminants. Almost every lighting company has possible customers who can not afford a number of incandescent lamps and who do not care to use a large enclosed arc lamp. In such cases particularly, for show-window lighting and for any place with limited room and for decorative purposes, the miniature enclosed lamp will be found very useful. Its weight, with glassware, is only 10 lbs., and its length is but 17 ins.

This company has just completed and had on exhibition at the convention of the American Street Railway Association at Kansas City, Mo., an enclosed arc headlight, which we illustrate. An interesting feature of it is the fact that the lamp connects directly across the street railway circuit, using a minimum current of 1 ampere, with a voltage across the arc of about 280 volts. The arc, although 1¼ ins. long, is remarkably steady and gives a splendid light when used with the parabolic reflecter supplied with the headlights. The lamp is entirely self-contained. The small amount of resistance required is placed in an apartment at the back of the lamp, instead of being placed on the platform of the car, as is usual in some cases, and is easily accessible. The lamp is entirely automatic in action, it requiring no hand feed, as in some headlights. A door in the upper portion of the lamp allows ready access to the working parts. The trimming is easily performed by removing the inner globe and taking out the carbons through the bottom of the lamp. One set of carbons will burn 100 hours.

Schmidt Automatic Reset Intercommunicating Telephone System.

The Lambert Schmidt Telephone Manufacturing Company, New York, is offering to managers of large establishments and to the trade in general an automatic reset intercommunicating telephone system which possesses some novel and interesting features. The instruments are made both of the desk and wall pattern, handsome in design and finish, strong and positive in their actions. The fundamental principle is the automatic disconnection of the telephone as soon as the talking is finished. Thus each telephone in the system when not in use is always in its normal position ready to be called. We show illustrations of both the wall and desk types.

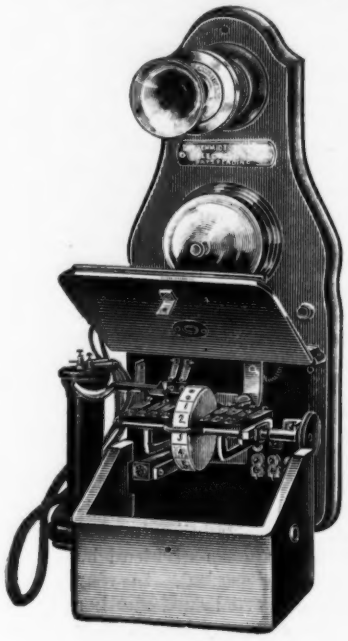


FIG. 1.

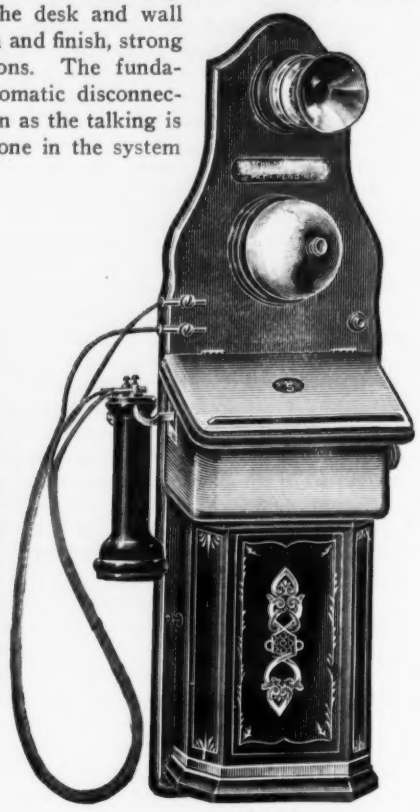


FIG. 2.

In the wall telephone, Fig. 1, the switching device is enclosed in a neat wood case. To operate, the receiver is taken from the hook and the finger-knob at the side is turned, revolving a steel centre shaft in the switch-box. On this shaft are arranged a set of pins projecting at different degrees, and, at regular intervals, these pins wipe against stationary springs fastened to a rack, on each side of the shaft. A cog-wheel with an automatic clutch, holding the shaft at each arc of revolution, is fastened to the left of the shaft. On the centre of the shaft is a wheel with a numbering strip, bound in a manner similar to a wheel tire and divided into sections corresponding with the arcs described by the pins. Each section is numbered and on the cover of the switch-box is a hole with a glass cover through which each number shows as the shaft revolves. Thus, when pin No. 5 is brought in contact with spring No. 5, the corresponding number shows through the glass. By the cog-wheel and automatic clutch is a spring releasing the clutch as the receiver is placed on the hook, to the shaft being attached a spring having a tendency to restore the shaft to the normal position. The user takes the receiver from the hook; makes the desired connection by turning the finger-knob, knowing that the connection is correct by the number showing through the front of the box; presses the calling button on the front of the telephone to signal the number; talks; and when through, hangs up the receiver and the switching device springs back to the normal position. Should he make a mistake and swing the shaft around to a number higher than that desired, he presses down the receiver hook, restoring the shaft, and begins over again.

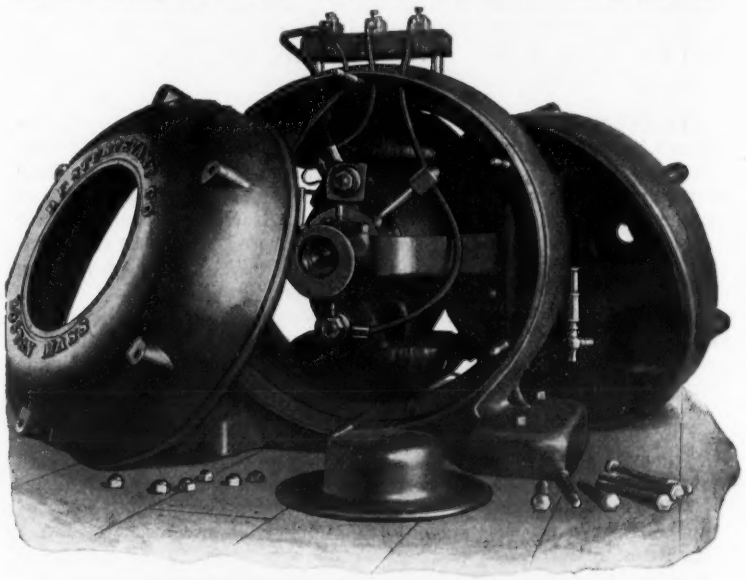
FIG. 3.

In the desk telephone (Fig. 3), Mr. Schmidt has designed a style using the hand micro-telephone normally laid across a yoke with a long projecting button in the centre of the cross-bar. The placing of the micro-telephone across the yoke presses down this button, which acts in a similar manner and for the same purpose as the receiver hook on the wall telephone. The switching device is substantially the same as that previously described, the box, however, being of highly polished nickel-plated brass with black enameled base. The box is fastened to the desk, the micro-telephone being provided with a long, silk-wrapped cord. The method of operation is similar to that of the wall telephone, the micro-telephone being removed from the yoke when a call is to be made and laid across the yoke when through, thereby pressing down the projecting button on the cross-bar and restoring the switching device to normal. This intercommunicating switching device is small and compact, with few parts. The illustrations show instruments with a capacity of 15 connections. Mr. Schmidt informs us that broad patent claims have been allowed him on this system. Fig. 2 shows a wall telephone set with backboard and battery box.

The Sturtevant Enclosed Electric Motor.

The bi-polar type of enclosed motor, the internal construction of which is illustrated in the accompanying cut, is manufactured both as a motor for direct connection to a propeller fan and as an independent machine. For the former purpose it is used on all sizes of fans up to and including the 54-in. For larger sizes the four and eight-pole types are employed.

The motor is entirely enclosed and thereby protected from dust. In order to avoid the excessive temperature which is incident to the operation of most enclosed motors, this type has been very carefully designed, so that a low temperature rise can be maintained without greatly increasing the size and weight above that of the ordinary open type. This machine is capable of continuous operation for ten hours, with a maximum temperature rise not exceeding 60 degs. F. Yokes extending out from the field ring support the armature shaft. The end casings are entirely independent and can be readily removed to give access to the interior. The bearings and brushes can be reached by removing the caps in the centre of the casing. The brushes are of hard carbon, in holders of a modified reaction type, which allows of easy adjustment when it becomes necessary to reverse the direction of rotation of the motor. The bearings are self-oiling and self-aligning, and fitted with composition sleeves, which are removable from the outer ends of the boxes. These motors, in sizes from 1-6 to 5 horse-power, are built by the B. F. Sturtevant Company, Boston, Mass.



PARTS OF ENCLOSED ELECTRIC MOTOR.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call ranged from 3 to 4 per cent during the week. Time money was inactive and closed weak as to rates. The demand was only moderate. The closing rates were 4½ per cent for 30 to 60 days, and 5 per cent for longer periods. There was a better demand for mercantile paper, and the market was quite bare of the highest grade names. Rates are 4¾@5 per cent for indorsed bills receivable, 5½@6 per cent for first-class single names, and 6 per cent and higher for names not so well known. In the stock market, there was much improvement both in tone and prices. The upward movement was general throughout the list, electrical securities along with the rest, closing with substantial advances. Local traction securities are higher, Metropolitan advancing on inside buying and Brooklyn Rapid Transit on the covering of shorts, 113,877 shares of the latter stock having changed hands during the week. The sales of General Electric were 4346, and that stock closed with a net gain of 2½ points. Other net gains recorded are: Metropolitan Street Railway, 6¼; Brooklyn Rapid Transit, 3¾; Western Union, ⅝. Outside securities were active, and nearly the entire list closed with net gains. At no time this year has there been such activity in the curb market, the electric securities sharing, with the other classes, in the general upward movement. Following are the closing quotations in the four cities named:

NEW YORK.

	Oct. 13.	Oct. 20.		Oct. 13.	Oct. 20.
Gen. Elec.	141	143½	Elec. Veh.	15	18
Bklyn Rap. Tran.	53	56¾	Elec. Veh., pfd.	*40	*40
Met. St. Ry.	151¼	157½	Gen. Car.	5	5
Am. Tel. & C.	—	89½	Ill. Elec. Veh. Tran.	1	1¼
West. Un. Tel.	79	79⅝	N. Y. Elec. Veh. Tran.	5½	6¼
Am. Dist. Tel.	27½	30	N. E. Elec. Veh. Tran.	2⅞	3⅜
Com. Cable.	—	160	Tel. & Tel. Co. of Am.	5	5½
Elec. Boat	13	18¼	Hud. Riv. Tel.	116	116
Elec. Boat, pfd.	24	32	N. Y. & N. J. Tel.	160	160

BOSTON.

	Oct. 13.	Oct. 20.		Oct. 13.	Oct. 20.
New Eng. Tel.	—	—	Erie Tel.	95¼	—
Mex. Tel.	—	—	Gen. Elec., pfd.	139	—
Westing. Elec.	47	—	Am. Tel. & Tel.	141	—
Westing. Elec., pfd.	—	64½	Ed. Elec. Lt.	—	—

PHILADELPHIA.

	Oct. 13.	Oct. 20.		Oct. 13.	Oct. 20.
Elec. Stor Bat.	60	65	Phil. Elec.	2½	2⅝
Elec. Stor. Bat., pfd.	62	70	Pa. Elec. Veh.	3	3¼
Elec. Co. of Am.	9	9⅝	Pa. Elec. Veh., pfd.	*1⅞	2
Gen. Elec. Auto	¼	¼	Am. Rys.	28⅞	31

CHICAGO.

	Oct. 13.	Oct. 20.		Oct. 13.	Oct. 20.
Chicago Edison	135	135	Chicago Telep. Co.	200	205
Chic. City Ry	244	247	Union Traction	11	11¾
Nat'l Carbon	16	16	Union Traction, pfd.	48	48½
Nat'l Carbon, pfd.	80	81	Northwest Elev. Com.	23	23½

*Asked.

WESTERN UNION.—It is a question whether Western Union cannot be regarded as one of the cheap stock on the list. It is true, says the *Wall Street Journal*, that the earnings of the company have not increased in the last few years in keeping with the improvement in the earnings of most large companies. Earnings, however, have been large enough to permit the maintenance of 5 per cent dividends for many years. The company shows a small annual surplus, but little more than 1 per cent of the gross earnings; still, it is a surplus and not a deficit. The increases in bonds have undoubtedly been in the main for additional property. The price of the stock, about 79, reflects a lack of confidence in the maintenance of 5 per cent dividends, but it would be a very fair price for the stock if the dividends were 4 per cent. A reduction in the rate from 5 per cent to 4 per cent would be a saving to the company of about $1,000,000 per annum. If the company were paying 4 per cent and showing a surplus of $1,300,000 a year, its position would be regarded as strong. The stock seems, therefore, to be in a place where it is certainly cheap if 5 per cent can be maintained, and is not particularly dear if the rate should be lowered to 4 per cent. It would return in the latter event over 5 per cent on the investment and the margin of safety would be considered ample. Looking at the matter from another standpoint, the company may not, it is said, make as good a showing the last quarter of this year as for the corresponding period a year ago, notwithstanding the increased business from the election, as the Postal Telegraph Company has the German cable business which formerly went by the way of Western Union. This business amounted to over 300,000 messages a year, and while for years one could send a cable by the Postal lines to Germany, the return message under the government system always went by the Western Union. Now the situation is reversed and the return messages are all by the Postal Telegraph Company, which has the direct German connection.

NEW ENGLAND ELECTRIC VEHICLE.—An official of the New England Electric Vehicle Company says: "The New England Transportation Company originally had $2,250,000 in cash. About one-half of this has been invested in plant, real estate and the business generally, leaving a balance, which is in bank at 2 per cent interest, of about $1,125,000. This would be equivalent to about $5 a share on the stock, or nearly $2 per share above the current market price of the stock, to say nothing of the company's plant, equipment, etc. For the year from Oct. 1, 1899, to Oct. 1, 1900, the receipts of the company in Boston were about $100,000 and the expenses $200,000. This loss was due to the disadvantages under which the company had to operate during the first year. The company, for instance, began business with a limited number of vehicles, while it was at the same time constructing its plant, thus preventing the most economical methods of operation. In Newport the results were more favorable, the company showing net profits of about $10,000 for the season. For the current month the Boston business shows a profit over expenses, and the net earnings during the 12 months ending Oct. 1, 1901, should, I believe, be in the neighborhood of $50,000 or $60,000, at least. This is on the basis of the company's present equipment, without further enlargement of the plant. The earnings in Newport next year should be at least $25,000. I should not be surprised to see the total profits of the company for the next year, including interest on funds in bank, amount to 5 or 6 per cent on the stock."

MASSACHUSETTS ELECTRIC COMPANIES.—The railroad commissioners have heard the petition of the Lowell, Lawrence & Haverhill Street Railway for authority to consolidate the Lowell & Suburban Street Railway. The petitioners also asked that the order of the board, limiting the dividends of the Lowell & Suburban Railway to 7 per cent per annum, be rescinded. It appears that in 1896 the board issued an order that the Lowell & Suburban dividend be limited to 6 per cent, owing to an impairment of capital. In 1897 this impairment was partially made up and the board issued another order limiting the dividend to 7 per cent. The company has entirely wiped out this impairment and now asks that the order limiting amount of dividends be rescinded. The Lowell & Suburban property is appraised at $2,340,000.

BOSTON ELEVATED.—The gross earnings of the Boston Elevated for the year ended June 20 are officially estimated at between $10,100,000 and $10,200,000, an increase of about $500,000 over the preceding year. June earnings were the largest for any single month in the history of the company, amounting to between $920,000 and $925,000. The company has made generous charges to operating expenses for new equipment, maintenance of way, etc., so that net earnings will not make as good a showing as gross earnings. About 245,000,000 passengers were carried during the year, as compared with 233,000,000 passengers the previous year. Free transfers issued amounted to between 45,000,000 and 50,000,000, as compared with 42,000,000 the previous year.

DIVIDEND.—Henry R. Worthington, incorporated, has declared dividend of 3½ per cent on preferred stock, payable Nov. 1.

Commercial Intelligence.

THE WEEK IN TRADE.—There was general quiet in trade last week, although there is a feeling of confidence pervading it all. This quietness is due, generally, to the lessening of jobbing distributive trade and the repressive influence which naturally precedes a national election. The best trade advices come from the South; on the Pacific Coast export trade is heavy, due to the requirements of the army in Asia; in the Northwest trade is quiet, and in the East a similar condition prevails. Gross railway returns continue satisfactory, notwithstanding the quietness in general trade. On 121 roads reporting for August the gross earnings have been $95,197,140 and the net $32,839,593, gains of respectively 7.7 per cent and 6 per cent. Foreign trade, Bradstreet's reports, is in a flattering condition, September exports being the largest ever reported for that month, and the nine months' returns are far in advance of all previous years. Structural material makers are reported to be exceptionally well supplied as to orders, although there are rumors of possible rate-cutting. Business failures for the week, as reported by Bradstreet's, numbered 223, against 210 the previous week, 221 the same week a year ago, 213 in 1898, 205 in 1897 and 292 in 1896. The copper market was dull and unchanged, transactions being limited to small lots. Quotations are: 16¾@16⅞ for Lake Superior ingot; 16⅜c. for electrolytic.

ELECTRICAL EXPORTS.—The electrical exports from New York for the week ending Oct. 7 were: Antwerp—19 cases electric material, $3,003. Bremen—4 cases electric machinery, $357. Brazil—2 cases electric material, $84; 23 packages electric machinery, $2,500. Brussels—1 case electric material, $28. British Australia—18 packages electric material, $975; 6 boxes motors, $4,080. British East Indies—18 packages electric material, $2,315. British West Indies—13 cases electric material, $269. British Possessions in Africa—2 cases electric material, $108. British Guiana—41 packages electric material, $1,417. Bristol—74 cases electric machinery, $4,700; 22 reels electric cable, $5,767. Budapest—8 packages electric material, $440. All other British Possessions—77 packages electric material, $2,650. Bordeaux—5 cases electric machinery, $491. Cuba—55 packages electric material, $1,529. Chili—4 cases electric material, $117. Central America—55 packages electric material, $2,494. Dunkirk—44 cases electric machinery, $790. Dublin—3 reels electric cable, $2,011. Florence—3 cases electric material, $194. Flushing—3 boxes electric cables, $135. Glasgow—15 packages electric machinery, $15,336; 4 reels electric cable, $16,835; 7 cases electric material, $228. Havre—3 cases electric machinery, $144; 125 packages electric material, $2,456; 6 cases automobiles, $2,814. Hamburg—50 packages electric machinery, $8,142; 24 packages electric material, $2,617. Liverpool—35 packages electric machinery, $6,010; 24 cases electric material, $1,199. Leith—6 cases electric machinery, $120. London—131 packages electric machinery, $12,735; 151 packages electric material, $28,-843; 6 cases motors, $475; 2 cases electros, $30; 93 Bessemer trolley poles, $1,768. Middlesborough—1 crate electric material, $20. Mexico—33 packages electric material, $1,742. Manchester—23 packages electric material, $4,060; 20 packages automobile parts, $1,000. Marseilles—27 cases electric material, $1,853. New Zealand—4 packages motors. $250. Nova Scotia—3 packages electric material, $23. Newcastle—12 cases motor machinery, $1,866. Newfoundland—1 package electrical material, $20. Peru—15 cases electric material, $464. Preston—3 packages electric material, $54. Riga—7 cases electric material, $1,155. Southampton—1 case electric machinery, $17; 1 case electric machinery, $21. San Domingo—18 packages electric material, $462. St. Petersburg—3 cases electric material, $302; 3 cases electric machinery, $67. U. S. Colombia—3 cases electric material, $44. Venezuela—44 packages electric material, $631.

EQUIPPING A LARGE MILL.—The Lancaster Mills, Clinton, Mass., Charles A. Richardson, agent, have lately been adding to their power plant. The total capacity is 4200 horse-power, as follows: 11 Cahall boilers, 500 horse-power each, generating steam for one cross-compound condensing Cooper-Corliss engine, 28 x 56 x 60, rated at 1700 horse-power at 160 lbs. steam and 75 r. p. m., and one cross-compound condensing Cooper-Corliss engine, 32 x 64 x 60, rated at 2500 horse-power at 160 lbs. steam, 70½ r. p. m. Direct connected to the smaller engine is a 1250-kw General Electric generator, three-phase, 40 cycles. Direct connected to the larger engine is a 1650-kw General Electric generator, three-phase, 40 cycles. The exciting outfit consists of one non-condensing vertical engine, 11-in. diameter and 8-in. stroke, 305 r. p. m., and 50 horse-power, connected to a G. E. multipolar generator, 240 amperes, 125 volts. This set excites either generator. After starting, the induction set consists of an induction motor, 50 horse-power, 40 cycles, 580 volts, 800 r. p. m., direct connected to one exciter generator, 250 amperes, 125 volts, speed 800. This set is run in parallel with another set exactly like it, and the two main generators are excited from either set. The generators furnish current to four 50-hp induction motors, one 75 horse-power, six 100 horse-power and nineteen 150 horse-power. All this is of General Electric make. A Westinghouse air-brake pump is used for blowing out the motors. The steam plant includes a Green economizer and Wheeler surface condensers.

RANGE OF PRICES.—A remarkable fall in the prices of manufactures in nearly all of the great classes is shown by the official figures of the Treasury Bureau of Statistics prepared for the current number of the Monthly Summary and by recent issues of Dun's and Bradstreet's, Comparing prices at the beginning of the present month with those at the beginning of the present year, a fall of from 10 per cent to 40 per cent is shown. Tin plate shows a reduction of 24 per cent on Oct. 1, 1900, as compared with Jan. 1, 1900; refined petroleum, 21 per cent; common window glass, 12 per cent; wire nails, 30 per cent; barbed wires, 26 per cent; Bessemer pig iron, 46 per cent; steel rails, 26 per cent; yellow pine lumber, 14 per cent; sisal rope, 38 per cent; manila rope, 32 per cent; leather, 10 per cent; shoes of various grades, from 7 per cent to 10 per cent; woolen dress goods of various grades, from 5 per cent to 12 per cent. While nearly all of the figures relating to manufactured articles show a reduction on Oct. 1, 1900, as compared with Jan. 1, 1900, nearly all figures on prices of farm products show an advance during the same time.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, of Chicago, has just closed a contract with the Greensboro Telephone Company, of Greensboro, N. C., to furnish a complete telephone equipment, consisting of a 1200-capacity central energy switchboard, distributing board and protective devices. The competition was quite spirited among the different manufacturers who submitted bids. A contract to equip Creston (Ia.) Mutual Telephone Company exchange with a Western Express switchboard of 300 lines, and another for a 200-capacity Western Express switchboard for the Sheridan Telephone Company, of Sheridan, Wyo., have been closed. The company is also furnishing a 300-line addition to the Gordon Telephone Company exchange at Charleston, S. C., and is putting in a 600-line re-equipment for the Shamokin Valley Telephone Company exchange, at Shamokin, Pa. It has also just completed installing a flashlight transfer system for the Home Telephone Company at Fort Wayne, Ind., and, in addition, it has received a large telephone order from the Southwestern Telephone Company, of New Albany, Miss.

SPRAGUE ELECTRIC COMPANY NEW OFFICE.—The Sprague Electric Company has recently opened a branch office in the Security Building, St. Louis. Mr. C. B. White, who is well known in the Western electrical field, will have charge. He was formerly connected with the engineering department of the old Edison Electric Company, having been located in Pittsburg, and having done considerable construction work in that territory. He was later electrical superintendent in charge of construction work with the Calumet Electric Street Railway Company, Chicago, and for the past two years has been connected with the Western Electric Company in the engineering and sales department. The Sprague Electric Company now has branch offices in Chicago, Boston and St. Louis, and agencies in all of the principal cities in this country and abroad.

"LLOYD'S," one of the largest newspapers in London, has recently adopted the Ward Leonard system of control for its 50-hp printing presses. Among the competitive systems for this important equipment were several other American concerns. A most careful investigation was made by the engineer of *Lloyd's,* who visited the Paris Exposition to see the Ward Leonard system, which is applied on the moving platform generator equipment. The result was that the order was placed with Geipel & Lange, of London, who represent Mr. Leonard in England. This is probably the most thorough investigation made of the various systems for printing press control, and it is also said to be the largest size of printing press thus far operated electrically.

ENCLOSED ARCS.—The Société Gramme are the exclusive licensees for Mr. Louis B. Marks on the Continent of Europe and under his direction installed the first enclosed arc lamps in France. A view of the Gramme exhibit at the Paris Exposition was shown recently in these pages. It included some of the Marks lamps. It is interesting to note that Gramme himself, then over 80, passed upon the lamps before the company adopted the system. A gold medal was awarded to the Marks lamp at the Exposition.

STEAM TURBINES.—Westinghouse, Church, Kerr & Company have received an order for the largest steam turbine ever built of 2500 horse-power for the Hartford (Conn.) Electric Light Company. The Hartford Company also purchased 800 horse-power of Roney mechanical stokers. The Parsons steam turbines are built in this country by the Westinghouse Company. The Paris exhibit of these interesting "electrogene" units was described in the pages of this journal a few weeks ago.

LARGE IMPROVEMENTS IN MILWAUKEE.—The Milwaukee Electric Railway & Light Company will soon let contracts for the erection of a new building to be used as a central car barn and for general offices, to cost $500,000. It is reported that the company will spend $10,000,000 on its Milwaukee property during the next five years.

JOHORE, INDIA.—Ibrahim, the Sultan of Johore, has entered into a contract with the General Electric Company for a plant costing between $700,000 and $800,000, to transmit power 98 miles, from a cataract to the gold mines belonging to the Government, and engineers have been sent to Johore to set up the plant, under contract to remain in the employ of the Sultan for a term of years.

THE SPRAGUE ELECTRIC COMPANY has secured from the New York Central Railroad Company the contract for ventilating the beautiful new Grand Central Depot, New York City. The ventilating fans, ranging in size from 18 to 60 ins., will be operated by Lundell electric motors.

AUSTRALIAN TELEPHONES.—Tenders for the erection of a telephone line between Sydney and Melbourne, a distance of about 500 miles, have been invited by the Postmaster-General of New South Wales, no bid to exceed $120,000. The premier of Victoria has authorized the bids.

A LONG OHIO LINE.—John P. Martin, of Xenia, Ohio, is pushing actively his Little Miami Traction Company, which proposes to build a 72-mile road for passengers, freight and mails, from Cincinnati to Springfield, Xenia, etc. About $2,500,000 will be required. Grades will not run above 1 per cent.

THE UNITED ELECTRIC COMPANY, of New Jersey, will add four 1000-kw Westinghouse units to its Newark plant, and a Stanley 750-kw unit to its Hoboken plant. The engines in each case will be furnished by the Pennsylvania Iron Works.

General News.

THE TELEPHONE.

BOONEVILLE, MISS.—The Cumberland Telephone & Telegraph Company was granted a franchise here.

PHILADELPHIA, PA.—The Delaware & Atlantic Telephone & Telegraph Company is extending its line to Blackwood.

ROACHDALE, IND.—The Roachdale Union Telephone Company has been incorporated and organized. Capital, $10,000.

DETROIT, MICH.—The Michigan Telephone Company has let contracts for the erection of two brick exchanges at Grand Rapids, to cost $13,000.

ST. CHARLES, MO.—The City Council has granted the Bell Telephone Company permission to construct a line of poles on certain streets in this city.

RICHMOND, VA.—The Newport News and Richmond Telephone & Telegraph Company is extending its lines from Warwick County to Williamsburg, Va.

FOSTORIA, OHIO.—The Oil Belt Telephone Company, of Fostoria, has been incorporated. Incorporators: K. T. Briggs, M. S. Wagner, J. S. Hoyman, T. J. Martin and R. L. Carle.

ATHENS, OHIO.—The Athens County Telephone Company has exchanges at Athens, Marshfield and Albany. It expects to effect a connection with the United States Telephone Company's lines on or before Jan. 1 next.

FRANKFORT, IND.—The Central Energy Telephone Company of Frankfort has been incorporated. Capital stock, $30,000. Its directors are John H. Murphy, M. W. Hopkins and William Pogue. The plant is in course of construction and will soon be in operation.

LOUISIANA, MO.—The Louisiana Telephone Company has purchased of C. B. Gillum the line from Bowling Green to Ashley. The company now has over 400 miles of telephone lines, giving it direct communication with nearly every town in Pike and surrounding counties.

FREDERICKSBURG, VA.—The Tidewater Telephone Company, of Gloucester, has now 175 miles of pole line, 428 miles of wire and 107 stations in operation. Arrangements have been made to open an exchange at Saluda and to extend the line to Tappahannock. It is also proposed to build a line from Gloucester court house to Walkerton.

CHARLOTTE, N. C.—The Cumberland Telephone Company has purchased the exchanges of the East Tennessee Telephone Company which controls lines in Kentucky, East Tennessee and other States, the exchange at Bristol, Va., being included in the purchase. This company will extend its system as far south as Louisiana, where it owns other exchanges.

PACIFIC COAST.—General Sabin, president of the Pacific Coast Telephone Company, published the following notice on the list of subscribers of San Francisco issued Oct. 1: It is the purpose of the management to extend the use of the telephone to every town, no matter how small, throughout the Pacific States, and in all of the cities and towns, to put a telephone, at the most reasonable rates, within easy and immediate reach of every person whose income is sufficient to permit him to ride on street cars.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company has now completed its network of exchanges throughout Allegheny County. A few days ago the company secured control of the Home Telephone companies in Wilkinsburg, Oakmont, Verona, Parnassus, New Kensington and other adjacent boroughs for the sum of $30,000. Next week the company will issue a bulletin containing a list of 2000 subscribers, whose telephones are all in operation. The company has altogether 7000 subscribers, and the connections with the central exchange are being made as rapidly as possible. It is expected that by Jan. 1 the service will be in first-class condition, and until then the company will not charge its subscribers anything for it. This is done as a compliment to the subscribers, who have shown their faith in the enterprise from the first.

ELECTRIC LIGHT AND POWER.

PASS CHRISTIAN, MISS.—The Pass Packing Company is putting in an electric light plant.

PEMBROKE, KY.—It is reported that Walter S. Bumbus will erect an electric light plant.

PINE BLUFF, ARK.—W. H. Keyser contemplates building an electric light plant in Pine Bluff.

LEXINGTON, KY.—The Lexington Railway Company will make improvements to its power house.

COLOMBO, CEYLON.—An electric lighting system is to be established here for commercial and street lighting.

GASTONIA, N. C.—The new electric light plant here is about completed. J. L. Ludlow will accept the work for the city.

SILVERTON, B. C.—It is proposed to form a company here to light this town and the village of New Denver by electricity.

BERLIN, WIS.—The Berlin Electric Light Company has decided to sell its plant to this city. The price is said to be $12,000.

MT. VERNON, ILL.—The city of Mt. Vernon has purchased the local water works and electric light plant, paying $60,000.

INDIANAPOLIS, IND.—During the recent fall carnival in this city there were 7000 electric lights placed on the soldiers' monument.

LEWISBURG, W. VA.—The Lewisburg Milling & Electric Light Company has contracted for the installation of an electric light plant.

BRANDON, MAN.—The Brandon Electric Light Company is now building a dam and will soon commence the erection of the power house and pole line.

OXFORD, N. C.—A special committee of the Town Council has been designated to investigate and hear proposals for the erection of an electric light plant.

VERSAILLES, KY.—The Versailles Electric Company has been incorporated, with a capital of $18,000, to build electric plants for heating, lighting, power, etc.

ASHLAND, KY.—The Ohio Valley Electric Company will expend $200,000 in improving its plant. The power house will be enlarged to furnish light to several cities.

WAUSAN, WIS.—The Chicago Municipal Construction Company, Chicago, holds a 90-day option on the plant of the Wausan Electric Company, valued at $75,000.

ARKANSAS CITY, ARK.—F. D. Hagar and J. Francis Small of St. Louis, Mo., are organizing a stock company to build water works, electric light plant and a 10-ton ice plant.

WARREN, OHIO.—The Economy Electric Company has been organized here with the following stockholders: P. L. Webb, George H. Jones, W. H. Smith, G. B. Sawyer and J. W. Powers.

HEMPSTEAD, L. I.—The special election that was held here on Oct. 9 to decide whether the village should own water and electric light plants resulted in a victory for municipal ownership.

BALTIMORE, MD.—The Hochschild-Kohn Company, of this city, has installed in its isolated plant, one 100-kw, and one 62½-kw, 125-volt Westinghouse engine type generators.

DES PLAINES, ILL.—There is no electric light in this place. A plant is much needed. Mr. F. E. Bell, president of the F. E. Bell Telephone Company, may be addressed on this subject.

VENICE, ILL.—The Victor Electric Light & Power Company, of Venice, has been incorporated. Capital, $40,000. Incorporators: G. A. Niemann, M. Niemann and F. Kohl, all of Venice.

TALLAHASSEE, FLA.—After injunction proceedings and an appeal, Moore & McCready of Atlanta, Ga., have been given the contract for a new lighting plant for the city of Tallahassee, Fla.

BALTIMORE, MD.—Charles Phelps, engineer of the municipal electric commission, has submitted specifications of a contemplated electric light plant for Druid Hill Park. The estimated cost is $10,223.

SALERNO, ITALY.—Messrs Specher & Company, mill owners, of this place, are building an extensive electric generating plant at Salerno, which is to supply current for lighting the towns of Carva and Vietri.

ST. LOUIS, MO.—The Scullin Gallagher Iron & Steel Company, St. Louis, has increased its lighting plant, and has placed a contract with the Western Electric Company, Chicago, for one 100-kw generator.

CITY OF MEXICO, MEX.—The new electric light system in San Angel, a prosperous suburb of the City of Mexico, will be inaugurated on Nov. 1. It consists of thirty arc lights and fifty incandescent lights.

OTTAWA, ONT.—Mr. E. B. Douglass, president of the Sault Ste. Marie Pulp & Paper Company, has planned a proposition to develop Kakabeka Falls, near Fort William, Ont., for electric light and power purposes.

NEW IBERIA, LA.—It has been decided by popular vote to issue bonds for the construction of water works and an electric light plant. M. T. Lewman & Company of Louisville, Ky., have the construction contract at $89,900.

KAUKAUNA, WIS.—The Kaukauna Electric Light Company has issued a new schedule of prices for light which are considerably higher than the old ones. The company states that if the prices are not satisfactory meters can be used.

LOS ANGELES, CALIF.—The electric linemen of Los Angeles, Cal., have been on a strike for some time, and neither employers nor employees show signs of yielding. The Los Angeles Electric Company is advertising for linemen in the San Francisco papers.

ELECTRIC DRIVE.—Bender Bros., Hamilton, Ohio, architects, are drawing up plans for a new plant to be erected in that city for the Jewel Carriage Company. There will be a separate power plant and the electric drive system will be used for all machinery.

SAN FRANCISCO, CALIF.—The People's Mutual Telephone Company, San Francisco, recently renewed the offer to give an option to the city on its projected plant. It is understood that the option will be accepted at the next meeting of the proper committee.

HERMOSILLO, MEXICO.—The new electric light plant in this city is now in operation. It is one of the best equipped electric light plants in Mexico and was constructed from plans and drawings by Florencio Monteverde, a well-known electrical engineer of San Francisco.

KIRKWOOD, MO.—Eighteen bids were submited to the City Council last week for furnishing the dynamo, electrical apparatus, engines, boilers, etc., for the lighting of the city. The St. Louis Electrical Supply Company was the successful bidder at the price of $15,200.

SAN FRANCISCO, CALIF.—The Gould & Curry Mining Company's Mill on the Comstock Lode was started up for a test run, Oct. 15. It is to be driven by electric motors receiving current from the Truckee River General Electric Company's plant, which was formally opened Oct. 20.

FLORENCE, ALA.—Edw. J. O'Beirne of Birmingham, Ala., has been granted an electric light franchise. Arrangements have been perfected for lighting Sheffield and Tuscumbia from the same plant which will be built on the Tennessee River. A steam-condensing plant will be installed.

MULBERRY GROVE, ILL.—There is an opening here for an electric light plant. An enterprise of this sort will find encouragement. There are twelve towns in this vicinity which would probably use elecric light. John Kurtz, of Vandalia, Ill., should be adressed on the subject.

SAN LUIS POTOSI, MEX.—Plans have been made and the construction will soon commence of an electric light and power plant at Rio Verde, near this city. It is proposed to furnish lights and power for the city of San Luis Potosi. The power will be obtained by damming the Rio Verde.

WILMINGTON, N. C.—A special meeting of the Board of Aldermen will be held during the present month to consider the question of the establishment by the city of its own electric light plant. There has been, it is said, considerable trouble with the present system, which is operated by a private company.

ROANOKE RAPIDS, N. C.—The Roanoke Navigation and Water Power Company, of this place, has let the contract to Morton, Reid & Company for a big electric plant on its canal. Lights will be furnished the town and possibly to Weldon, five miles distant. Power for cotton mills will also be furnished.

NEW YORK, N. Y.—The Brooklyn Navy Yard electric light and power wires are all to be placed underground. The conduits to carry these wires between the new power station and the old plant controlled by the department of construction are now being laid. The new shops are being wired and equipped for electric power.

HATTIESBURG, MISS.—The Hattiesburg Light & Power Company has purchased the electric light branch of the Hattiesburg Electric Light & Manufacturing Company. It is remodeling its entire plant, installing new machines and doubling its capacity. Mr. R. H. Hemphill is secretary and manager of the company.

SHAMOKIN, PA.—The Shamokin & Coal Township Light & Power Company will begin the construction of its plant as soon as it secures the passage of an ordinance in the City Council. The ordinance has passed the second reading. The incorporation of this company was announced in a recent issue, together with the names of its officers.

FRANKFORT, IND.—Suit has been brought against this city to declare the city's contract for the erection of the municipal electric light plant null and void, because of exceeding the constitutional limitation of indebtedness. The case is attracting attention throughout the State, because of questions involving other cities similarly situated.

ELKHART, IND.—The Home Electric Light and Power Company one year ago was granted a franchise extension of five years. Recently New York capitalists bought the plant, and they have asked that the franchise be extended for fifteen years because it is intended to spend $17,000 in improvements. This proposition has stirred up a healthy opposition and served to start a substantial boom for municipal ownership. The City Council, it is thought, will not grant the extension.

SAN FRANCISCO, CALIF.—The Truckee River General Electric Company has decided to formally turn on the electric power which will supply the Comstock mines, Saturday, Oct. 20. A committee of Comstock superintendents has prepared for a celebration and the reception of a large party of guests. The electric generating station in Floriston, Calif., will be inspected on Sunday on the return trip. Consulting Engineer Leon M. Hall has made a favorable report on the entire transmission system to the Comstock Pumping Association.

ALBANY, N. Y.—The Montgomery Power Company, with a capital of $100,000, has been incorporated. The company will furnish electric light, heat and power for lighting the streets of Amsterdam, Johnstown, Gloversville, the towns of Florida, Glen, Mohawk, Galway, Perth, Broadalbin and the villages of Rockton, Hagaman, Fultonville, Fonda, Tribes Hill and Fort Hunter. The directors are William K. Archbold, Paul T. Brady, Robert T. Drake, of Syracuse; W. Barlow Dunlap, William B. Charles, Robert R. Reed, of Amsterdam, and Jacob Snell, of Fonda.

SAN FRANCISCO, CALIF.—The Mammoth Electric Company was recently incorporated, with Hanford, Calif., as the principal place of business. Alexander Guthrie, of Balfour, Guthrie & Company, is president; J. Shaw Robertson, vice-president; E. Kauntze, secretary; Bank of Hanford, treasurer. Hugh McCalmont, an English capitalist, is a heavy stockholder. The capital stock is $5,000,000, fully subscribed. A hydraulic electric power transmission plant will be installed on the San Joaquin River, 180 miles from San Francisco, the objective point.

ST. LOUIS, MO.—Supervisor of Lighting A. J. O'Reilly made his report last week for the year ending April 9, on what has been done in the subway work since March 1, 1897. At this time there are 1,083,360 feet of trench including 165,220 miles of cable, 756,274 miles of pole lines and 34,675 poles along streets. The Lighting Committee of the Board of Public Improvements will probaby soon submit a report urging the adoption of measures to cause an extension of the conduit district, as far north, south and west as seems necessary for public safety.

CARBIDE PLANT.—A special dispatch from Hamilton, O., of Oct. 19, says:—Ex.-Gov. James E. Campbell has just closed a big deal, which will, it is expected, put him upon his feet again financially. He has organized the Columbian Carbide Company under the laws of West Virginia, with $5,000,000 capital. The company has secured a new process which, it is claimed, will give it a monopoly of the field. Headquarters will be in New York. The incorporators are James E. Campbell, Hamilton; A. O. Campbell, Columbus, Ohio; D. Murphy, Jersey City; G. C. Adams and F. J. Patten, New York.

CITY OF MEXICO, MEX.—Messrs. S. Robert & Company, of this city, are putting in an electric light system in the towns of Mixcoac, Coyoacan and Tlalpam, all flourishing suburbs of the City of Mexico. Coyoacan will have 150 incandescent and six arc lights; Tlalpam will have 30 arc and 70 incandescent lights and Mixcoac will have 30 arc and 150 incandescent lights. The power for this system comes from the mountain stream above Contreas, where the company has established a plant with two generators, each having a capacity of 375 horse-power. Another generator with a similar capacity is to be added to the plant very soon. Mr. Emilio Meyran is general manager of the plant.

MONTREAL, QUE.—At a recent meeting of the water committee of the city of Montreal specifications were considered for the proposed erection of the new electric engine for pumping water at the low water reservoir of the city. By economy this year the committee is in a position to vary $30,000, by which this engine can be put up. The committee decided, therefore, that tenders should be called for at once on the specifications, but it is not expected that the pumps will be in working order until early in the coming year, as to obtain such machinery some delay is inevitable. Canadian and American firms are expected to send in tenders. It will be arranged so that electric power may be obtained from any of the electric power companies in Montreal.

THE ELECTRIC RAILWAY.

ST. MICHAEL, AZORES.—An English company is to build an electric railway on this island.

SALERNO, ITALY.—It is proposed to build an electric railway from this city to various points in this vicinity.

SPARTANSBURG, S. C.—The Spartansburg Electric Railway has been extended to Clifton, S. C., and now has 10 miles of line in operation.

ST. CLAIRSVILLE, OHIO.—A franchise through Belmont County has been granted to W. R. Stevens, promoter of an electric line from Bridgeport to Cambridge.

MOUNDSVILLE, W. VA.—A connection between the Moundsville Street Railway line and the Wheeling Street Railway at Benwood, W. Va., will be built by H. T. Day.

HAMILTON, OHIO.—The Millcreek Valley Electric Railway Company is in a fair way to carry out its promise of building an extension of its line from Carthage into Hamilton.

NEW YORK, N. Y.—The Third Avenue Railroad Company reports for the quarter ended June 30 gross earnings of $584,086, an increase of $49,024, and net $242,229, a decrease of $44,281.

CHILLICOTHE, OHIO.—The Chillicothe Street Railroad Company is preparing to extend its line and will open up new territory in the eastern part of the city by the construction of a loop road.

HANNIBAL, MO.—The Hannibal Railway & Electric Company was incorporated last week. Capital stock, $100,000. Incorporators: Herbert J. Beaty, George D. Clayton, John K. Adams and others.

SPRINGFIELD, OHIO.—The Springfield Railway Company has amicably adjusted differences existing with motormen and conductors. A nine-hour schedule was agreed upon, but the company declined to increase wages.

INDIANAPOLIS, IND.—The Indianapolis Street Railway Company will install a storage battery plant and eventually build an additional power house on some recently purchased ground. The improvements will cost $500,000.

DAYTON, OHIO.—A rumor is afloat that a broker representing Wall Street capitalists has been successful in consolidating all the electric roads entering Dayton, with the exception of the Southern Ohio Traction Company.

COLUMBUS, OHIO.—It is stated that Adam Grant, owner of the Columbus & Grove City electric line, has closed a deal whereby his road is to be transferred to the new Columbus, London & Springfield Electric Railway Company.

CLEVELAND, OHIO.—The gross earnings of the Cleveland, Painesville & Eastern Electric Railway from Jan. 1 to Sept. 1 were $91,691, against $79,910 in the corresponding time last year. The net earnings were $48,881 against $28,974.

ALLIANCE, OHIO.—The promoters of the Alliance, Sebring & Salem Electric Railway are said to be considering a proposition for the purchase of the plant of the Alliance Gas & Electric Light Company for use as a power plant for the new road.

COLUMBUS, OHIO.—The Commissioners of Franklin County have granted a franchise to the Chillicothe, Mt. Sterling & Columbus Electric Railway Company, which has been accepted conditionally upon the granting of a city franchise by the Council.

ATLANTA, GA.—H. M. Patty, representing the bondholders, has purchased for $5,000 the Lakewood electric street railway in this city. It is stated further that the Atlanta Railway & Power Company will build a new line to Lakewood, costing probably $30,000.

HARRISBURG, PA.—The Apollo, Vandergrift & Leechburg Electric Railway has been incorporated. Capital, $25,000. Incorporators: J. Q. Cochrane, S. M. Nelson, both of Apollo; J. B. Keifer, E. Hill, J. D. Orr, all of Leechburg; S. B. Cochrane, of Kittanning.

VERONA, PA.—The Borough Council of Verona passed an ordinance permitting the Wilkinsburg & Oakmont Street Railway Company to build its tracks through this town. The line is to run from Wilkinsburg, through Verona, to Oakmont, a distance of eight miles.

INDIANAPOLIS, IND.—Because of a protest by the superintendent of the fire alarm system the board of public works has ordered the Indianapolis Street Railway Company to change its system of overhead feed wires and place them underground in the downtown districts.

ALBANY, N. Y.—The Schenectady Railway Company has been incorporated, with a capital of $200,000. The directors are Philip F. Kobbe, William Henry White, Joseph T. Ord, Alick G. MacAndrew, George W. Hebbard, G. W. Jones, Lewis L. Clarke, John Kruesi, Charles A. Lieb.

LORAIN, OHIO.—The Cleveland, Elyria & Western Electric Railway Company and the Sandusky & Interurban Railway Company have settled differences as to the ownership of track on a street where both had a franchise. The latter company will own the track, the former paying rental.

CHARLESTOWN, W. VA.—The Traction & Electric Company, of Montgomery, went into the hands of receivers on Sept. 29. George S. Gough, of this city, and George S. Wallace, of Huntington, were made receivers. This follows the collapse of the Montgomery Bank, which occurred recently.

INDIANAPOLIS, IND.—Members of the Central Traction Company, of Indiana, announce that the contract will be let soon for the building of an interurban electric line from this city to Elwood and Kokomo. The power house will be located at Noblesville, and the line will have the most modern equipment.

HERMOSILLO, MEXICO.—The street railway company in this city is laying track upon the extension of its lines, completing the circuit of that city. The new track is narrow gauge, and when it is completed that part of the line heretofore constructed will be reduced to the same width and lighter cars will be substituted.

VERA CRUZ, MEXICO.—The Vera Cruz Railways, Limited, an English syndicate, with a capital stock of $3,750,000, has just purchased the street railway system of this city. This system is 12 miles long, and is to be immediately extended by the new owners, and electricity substituted for the present mule power.

CHILLICOTHE, OHIO.—The Chillicothe & Hillsboro Traction Company has filed a mortgage with the Ross County treasurer in favor of the Produce Exchange Trust Company, of New York, for $1,300,000. The mortgage is covered by 5 per cent, 40-year bonds. Dr. Charles Hoyt is president of the company, and W. H. Wallace, secretary. Surveying will be started at once.

AKRON, OHIO.—Having been refused a 50-year franchise by the Commissioners of Summit County, the promoters of the Portage Lakes Traction Company propose to change the route of the road, avoiding Twinsburg and going direct from Hudson to Highland Spring station of the Northern Ohio Traction Company, using the tracks of the latter company into Cleveland.

YOUNGSTOWN, OHIO.—The franchises and right of way of the projected Youngstown & Sharon Electric Railway have been transferred to Messrs. Penhale and Fisher, of New York, and Levitt Tremble & Company, of Chicago. The same people have also bought the stock and franchises of the Youngstown Lighting Company, both gas and electric. The consideration for the latter property was $500,000.

CHILLICOTHE, OHIO.—The fight between two rival companies that proposed to build an electric line from Columbus to Washington C. H. having reached such a point that it was feared both projects might be defeated, a consolidation was effected and a new company, composed of J. M. Wilson, D. I. Worthington, Frank Johnson, A. C. West, Hugh Stewart and W. R. Smith, will carry out the project.

PITTSBURG, PA.—The office force of the West End Traction Company gave an informal dinner the other day to their chief, Mr. Eugene S. Reilly, the general manager of the company, upon his return from the Paris Exposition. Those present were: Harry O'Toole, claim agent; James Fennelly, cashier; Thomas A. Davin, road superintendent; Joseph Mangen, chief dispatcher; W. J. Burns, treasurer; Phillip B. Reilly, J. A. Burns, W. A. Holladay and W. A. Kane.

PLAINFIELD, N. J.—The Riker-Hine syndicate has combined all its trolley interests in this part of the State under the corporate title of the Elizabeth, Plainfield & Central Jersey Railroad. This includes the street railway system in this city, the line between here and Elizabeth, the cross-country line from Westfield to Rahway, the old Union & Middlesex Street Railway, running to Boynton Beach and Woodbridge, and the Elizabeth Horse Car Company, the latter being recently acquired from U. S. Senator John Kean.

NEW YORK, N. Y.—The Metropolitan Street Railway Company announces that it has finished all of the street work it will do this year. In the year just ended the company has spent about $5,500,000 for the most part on power houses and motive power changes. Nine miles of Lexington Avenue have been equipped for electric traction; 6½ miles of Columbus Avenue have been electrically equipped; 10¼ miles of the Broadway road have had new rails laid, and the street surface repaved, and three crosstown lines have been reconstructed.

NEW YORK, N. Y.—An argument in favor of the immediate installation of the electric system on the Broadway car line was furnished on Oct. 9, when both of the cables broke, and at a time when traffic was heaviest. The road was tied up for several hours as a consequence. One cable broke, and the reserve cable was at once pressed into service. This, too, soon snapped in two under the heavy strain placed upon it, incident to the extraordinary traffic on account of rain and the stormy weather. The section of the road from Thirty-sixth Street to the Battery was affected.

THE AUTOMOBILE.

ST. LOUIS, MO.—The Scott Automobile Company has been incorporated here with a capital stock of $30,000, one-half paid up. The incorporators are: Charles R. Drummond, Semple S. Scott and W. Davies Pulman.

AUTOMOBILES IN SAN FRANCISCO.—The Park Commissioners recently took action which resulted in an ordinance being passed admitting automobiles to Golden Gate Park, San Francisco. On Oct. 17 the machines were admitted for the first time, and automobile business should begin to boom after a long and vexatious delay.

BOSTON, MASS.—The New England Electric Vehicle Transportation Company is considering the establishment of an electric vehicle transportation line on Marlboro Street in case the horse car tracks are removed. The Boston Transit Company, which is owned by the New England Company, has been granted the right to maintain a line of automobiles on certain Back Bay streets.

"KNOCKING DOWN" has long been a vice among cab drivers. The recent action of the New York Court of Special Sessions in dealing severely with the first case brought before it by the Electric Vehicle Company—that of William Dollard—may serve to make the thievery less popular. Dollard was sent to the Tombs for four days pending his sentence, and was then sentenced to ten days in jail for taking a dollar out of the fare paid by a passenger. He made an appeal to the clemency of the court by getting married between the time of arrest and that of conviction. But for this fact his sentence might possibly have been heavier. The practice on the part of the drivers works against the passenger as well as against the company, inasmuch as "knocking down" and overcharging go hand in hand.

NEW INDUSTRIAL COMPANIES.

THE AIGLON ELECTRIC COMPANY, of New York City, has been incorporated. Capital, $5000. Directors: Jules E. Serre and Gustav Nordin of New York City and H. R. Anderson, of Rahway, N. J.

THE BISHOP ELECTRICAL COMPANY has been organized in Wilmington, Del. Capital, $50,000. Incorporators: F. L. Tapscott, G. P. Johnson, H B. Solten, M. D., H. J. Shaw, all of New York City.

THE ELECTRO PURIFICATION APPARATUS COMPANY of New York City has been incorporated. Capital, $50,000. Directors: Philip Hartensfels and P. S. Homer, of New York City, and W. R. Chipmen, of Jersey City.

THE MODERN ENGINEERING COMPANY of Wellsville, Ohio, has been incorporated. Capital, $150,000. Incorporators: C. R. Dallas, H. L. Ken, G. B. Thurber, C. E. Reed, all of Pittsburg, Pa.; T. Charlton, of Chicago, Ill.; C R. Dallas, attorney, Pittsburg, Pa.

LEGAL.

TO SELL AN ELECTRIC RAILWAY.—In the district court at Austin, Tex., judgment for $50,000 has been rendered against the Austin Dam & Suburban Railway Company. Of this amount $10,000 is in favor of J. H. Raymond & Company, local bankers, and $40,000 in favor of the intervenors, the First National Bank, of Austin. The court authorized the receiver to sell the road.

OBITUARY.

U. H. PAINTER died at Long Branch, N. J., on Oct. 20. He was a famous war correspondent and was at one time deeply interested in electrical development. Uriah Hunt Painter was born in West Chester, Pa., in 1837, educated at Oberlin College, and at the age of 20 succeeded to his father's lumber business in Westchester. At the beginning of the Civil War he went to Washington as the correspondent of the *Philadelphia Inquirer* and had charge of its corps of correspondents in the field. At the first battle of Bull Run he escaped capture by temporarily donning a surgeon's apron in the field hospital, afterward making his way to Washington. Foreseeing the news of the Union disaster would not be permitted to pass the censor, Painter took a train to Philadelphia and his paper printed a full account of the battle twenty-four hours in advance of its competitors. After the battle of Chantilly he sent to Washington the information that Lee's army was about to invade Virginia. As no such reports had been received from army officers, Secretary Seward, considering it treasonable, intended for effect abroad, insisted on his arrest. When the news was confirmed later by Lee crossing the Potomac, the correspondent was released from surveillance. His relations with Lincoln and Stanton were close, and a standing order at the White House admitted him to the President at any hour. After the close of hostilities he remained in Washington as correspondent for the *Inquirer* and subsequently for the *New York Sun* and *New York Tribune*. Mr. Painter was one of the first financial backers, with E. H. Johnson and others, of Thomas A. Edison in the launching of the phonograph, and was also connected with the introduction of the Bell telephone. At one time he held the option for the telephone patents which he endeavored to sell to Jay Gould for the Western Union Telegraph Company. Gould thought it would never amount to anything except as a toy and declined to purchase. The local Bell telephone company in Washington, one of the first in the world, was organized by Mr. Painter. At one time he was actively interested in the Sprague motor.

PERSONAL.

DOANE—JACKMAN.—The marriage is announced on Oct. 17 at Marlboro, Mass., of Mr. Samuel Everett Doane to Marion M., daughter of Mr. and Mrs. Joseph Varnum Jackman.

MR. A. K. WARREN, mechanical and electrical engineer, has associated himself with Mr. A. B. Herrick, with headquarters at 120 Liberty Street, New York. This makes a strong team.

MR. H. C. WYBRO, manager of the Wybro-Hendry Company, which represents the Bullock Electric Manufacturing Company in San Francisco, is making an extended tour of the Eastern States.

MR. M. H. FISHER, recently of the General Electric Company, is the new superintendent of the Columbus, Miss., Light & Power Company, which proposes to make some quite extensive improvements.

MR. BION J. ARNOLD is home from Europe, where among other things he has been studying the use of alternating-current motors on electric railroads. He traveled extensively in Switzerland, Italy, etc., and acquired a large amount of data at first hand.

PRESIDENT C. J. GLIDDEN, of the Erie Telephone & Telegraph Company, was in the city this week to take part in the annual meeting and election of the Automobile Club. He is an enthusiastic "mobler," and has three electrics, all of which he handles himself with skill.

MR. C. O. MAILLOUX returned last week with his wife from Europe, where he spent several months. After an active and brilliant participation in the Electrical Congress, where his technical ability and unusual command of French gave him a conspicuous position, he visited a large number of electrical plants all over the continent.

MR. ANTONIO ANDUJAR, of 138-140 Front Street, New York City, notifies us that his export business will be carried on hereafter by the Antonio Andujar Company. Their field is Latin-America on this side of the Atlantic, and they give special consideration to manufacturers who wish to introduce their products in Spain.

MR. IVAN M. JOHANSON has accepted the position of superintendent with the General Incandescent Lamp Company, of Cleveland, Ohio. He was formerly connected at different times with the Columbia Lamp Company, the De Lavals Glodlampfabrik Swea, of Stockholm, and the Beacon Lamp Company, of New Bruswick, N. J., and has the reputation of being a very expert lamp manufacturer.

MR. N. S. AMSTUTZ, of Cleveland, O., who has for some time past been associated with the Interstate Electric Co., of that city, has withdrawn from such connection and is now associated with Amstutz-Osborn Company, designing, supervising and constructing engineers, located in the Caxton Building, Cleveland. They have fitted up works with the finest machine tools, etc., and are prepared to construct special automatic and other devices requiring the highest precision. They also solicit United States and foreign patents and the works afford entire privacy to their clients while such devices are being perfected.

EDUCATIONAL.

TEN LECTURES will be conducted by Mr. A. A. Hammerschlag, on electrical subjects of a practical character, under the auspices of the New York Trade School, beginning Nov. 2 and running until March 15. They will be illustrated by experiment and demonstration.

PURDUE UNIVERSITY.—*The Indianapolis Press* of Oct. 18 devotes an entire page to an interesting description, with illustrations, of Purdue University Portraits of some of the professors are given, including one of W. E. Goldsborough, professor of electrical engineering. Views are also shown of some of the principal buildings, both interior and exterior. The story is well written, and includes a very good historical sketch of the institution.

ELECTRIC POWER TRANSMISSION.—The October number of the *University of Tennessee Record,* published by the University of Tennessee, Knoxville, Tenn., contains an interesting article on electric transmission of power in the shops of the university, Prof. J. R. McColl, professor of mechanical engineering, being the author. Other electrical articles included in the *Record* are: An Electric-Recording River Gauge, by W. W. Fulton; The Electrolytic Determination of Copper, by Wm. P. Grainger; A Photometer with Direct Reading Scale, by Charles A. Perkins.

RENSSELAER POLYTECHNIC.—The Rensselaer Polytechnic Institute, Troy, N. Y. will have in operation by November, 1900, a new electrical laboratory containing 16 machines, generators and transformers together with a full equipment for practical tests. There will be installed at the beginning one 20-hp direct-current motor, compound wound, 500 volts; one 6-hp direct-current motor, 100 volts; one 10-hp induction motor, 300 volts; one 7½-kw direct-current generator, 500 volts; one 7½-kw alternate-current generator, 500 volts, two-phase; one 7½-kw alternate-current generator, 500 volts, three-phase; two 10-kw rotary converters with connections for two or three-phase, 500 volts, direct current; two auto-transformers, 3¾ kilowatts, with connections for two-phase or three-phase currents; four oil transformers, 3¾ kilowatts, arranged for changing from two-phase to three-phase voltages ranging from 100 to 10,000; one rotary transformer 7½ kilowatts, 100 volts and 500 volts. The laboratory for the test of materials of engineering will be increased by the addition of one 300,000-pound testing machine and one 100,000-pound testing machine, and a 10,000-pound wire testing machine. The two former will be operated by an electric motor.

Trade Notes.

REMOVAL NOTICE.—The Holophane Glass Company has removed to its new offices at 15 East 32d street, New York.

IRON BOX BELLS.—The Electric Appliance Company, Chicago, is sending out quotations showing a reduction in price on iron box bells.

THE WESTERN ELECTRIC COMPANY, Chicago, has secured a contract for one 125-kw type "L" generator to be installed in the Spitzer Building. Toledo, Ohio.

OIL FILTERS.—The Western Electric & Manufacturing Company has just entered its third order with the Burt Manufacturing Company, of Akron, Ohio, for Cross oil filters for use in its works.

REMOVAL.—The Philadelphia branch of the Jandus Electric Company and the Buckeye Electric Company, Cleveland, Ohio, has been removed to Room 920, Real Estate Trust Building, Broad and Chestnut streets.

ROOFING TESTIMONIALS.—The H. W. Johns Manufacturing Company, New York, has just issued a roofing testimonial catalogue. It shows a number of illustrations of buildings covered with H. W. Johns' asbestos roofing.

SWITCHBOARD INSTRUMENTS of all types and styles manufactured by the General Electric Company are illustrated and briefly described in a 24-page pamphlet just issued from the company's press. Price lists are also included.

STURTEVANT MOTORS AND GENERATORS.—The B. F. Sturtevant Company, Boston, Mass., in bulletin S, describes its four-pole motors and generators for direct current. Illustrations of this type of machine and dimension diagrams are given, together with prices.

INSULATORS.—Messrs. E. R. Reed & Company, 315 Quincy Building, Denver, Col., are sales agents in Colorado, Utah, Wyoming and New Mexico for Locke insulators. They will carry a line of samples and are ready to quote on Locke insulators and pins in any quantity.

McDOWELL & CO., manufacturers of gas engines in Pittsburg, Pa., have just completed negotiations with the Pennsylvania Title & Trust Company for the purchase of a piece of property on River Avenue, Allegheny City, where the firm will erect a factory for the manufacture of engines.

DRAWING MATERIALS.—The Keuffel & Esser Company, New York, has just issued a very complete catalogue of its extensive line of drawing materials, mathematical and surveying instruments. The book contains nearly 500 pages, 50 more than was contained in the preceding edition. Many new instruments have been listed.

THE PITTSBURG COAL COMPANY is erecting car works at Montour Junction, on the Pittsburg & Lake Erie Railroad, with a capacity of 300 cars a year. These works will be operated by electricity. The equipment of the power house consists of a number of motors and generators, which were furnished by the General Electric Company.

POLYPHASE ALTERNATORS.—The Westinghouse Electric & Manufacturing Company in Circular No. 1031 describes and illustrates the construction of its belt-driven polyphase alternators. These machines are designed for 7200 alternations per minute; 220, 440, 1100 and 2200 volts. Views of 180-kw and 375-kw, two-phase alternators are shown.

CENTRAL STATIONS AND CONSTRUCTION COMPANIES have more or less demand for fixtures. The Western Electric Company, Chicago, has a large assortment of portables, brackets, stationary and adjustable fixtures to meet this demand. A 150-page fixture catalogue, just issued, illustrates these goods in a very comprehensive manner, and will be sent on request.

INTEGRATING METERS.—The Fort Wayne Electric Works, Fort Wayne, Ind., have issued an instruction book concerning their type K integrating wattmeters. Instructions are given for installation, testing, adjustment, reading, etc., and diagrams show the method of connecting the instruments. This type of instrument was described and illustrated in these columns on Oct. 13.

ENGLISH AGENCY.—The Chase-Shawmut Company, Boston, Mass., announces that Messrs. Robert W. Blackwell & Company, Limited, London, England, now represent it in Great Britain and France. The English agents will carry a varied stock of fuse wires, fuse links, enclosed fuses and switches, and will thus be able to take care of the increasing business in those countries.

TELEPHONE APPARATUS.—Illustrated catalogue E, just received by the Couch & Seeley Company, 26 Binford Street, Boston, Mass., shows this company's line of apparatus to be a very complete one. The company manufactures telephones, switchboards and telephone accessories, coal grain transmitters, receivers, etc., in many styles. The catalogue has 48 pages, is well illustrated and gotten up. The descriptive matter is brief but right to the point.

SMALL MOTORS.—We have received from the Sterling Electric Motor Company, Dayton, O., a copy of its Circular No. 7 containing some half-tone illustrations of its Sterling direct current motors, a short description of which appeared in our issue of Oct. 6, and a complete description of their construction together with a detailed explanation of the company's system of building and rating its product. The company will be pleased to mail copies on application.

ELECTRIC LOCOMOTIVES FOR LIGHT RAILWAYS is the subject of a pamphlet of the C. W. Hunt Company, New York. The locomotive made by this company and described in this pamphlet is of a type radically different to that of the usual machine of this class, in that it derives its power from a storage battery. It is thus independent to move wherever there is a track of proper gauge. These locomotives are suitable only for yard or intermittent work and not for long hauls or heavy grades.

MECHANICAL DRAFT.—That the advantages of mechanical draft are recognized by experts, and that it is rapidly assuming its place as a rival and successor of chimney draft, is clearly evidenced by the fact that several of the technical schools have recently placed orders with the B. F. Sturtevant Company, Boston, Mass., for the equipment of their boiler plants with this means of draft production. In several cases the fans have been so installed as to provide opportunity for experimentally comparing the chimney with the fan.

AMERICAN STEEL & WIRE COMPANY'S PARIS AWARDS.—The American Steel & Wire Company informs us that it received more grand prizes and gold medals than any other American exhibitor at the Paris Exposition. The awards include four grand prizes and two gold medals. Two gold medals and a collaboratory gold medal were awarded each to President Palmer and Chief Engineer Daniels "expressive of appreciation for their share in making such a show for their company." This company's exhibit was described and illustrated in these columns in the issue of Aug. 4 last.

POOR'S MANUAL.—We have received advance sheets of the introduction to "Poor's Manual of Railroads for 1900" containing the tabulated statistics of railroad operations in 1899. The complete volume contains, besides the general introduction and the special reports of individual companies, and other features in previous issues of the Manual, an elaborate "Study in Railway Statistics," being a review of the statistics of the development, finances, etc., of the railroads of the United States, with special reference to the period from 1880 to 1899. This reviews construction, consolidations, financial history, receiverships, foreclosures, reorganizations, etc., and is very valuable.

A PROSPEROUS YEAR.—In various ways the mileage of the New York Central Railroad has been increased during the fiscal year which closed on June 30 last until the road now owns and controls more than 10,000 miles of road. The annual report, which covers the operation of only 2817 miles, shows remarkably satisfactory conditions. The increase in gross earnings over the previous year was not far short of $6,500,000, $2,000,000 of this being due to increased mileage and nearly $4,500,000 to general trade activity. The report also shows a wise disposition of this increased income and a tendency to useful economies in more than one direction for the benefit of the public.

THE WISCONSIN GRAPHITE COMPANY, Pittsburg, Pa., has been organized by Messrs. Howard R. Swearer, John R. Snodgrass, W. W. Pipes, Edward D. Steinman and Fred J. Shaler, for the sale of Wisconsin graphite made by the Portage County Graphite & Mineral Paint Manufacturing Company, of Stevens Point, Wis. The new company has secured the exclusive agency for this product in the States of New York, New Jersey, Pennsylvania, Ohio and West Virginia, and has established its headquarters in the Builders' Exchange. The product of the Wisconsin company is specially suitable for making crucibles for melting metals, foundry facings, lubricating, painting and many other purposes.

ORGANIZATION AND SYSTEM.—The New York Central & Hudson River Railroad Company every now and then publishes, through its passenger department, a pamphlet or a leaflet which contains valuable lessons to practical men. These lessons are not taught as lessons are taught in school, but through the instrumentality of an interesting story. A recent pamphlet is entitled "A Green Hand's Story." It is short and worth reading carefully and pondering over. The underlying truth in this story is that intelligent and faithful individuals working together to a common end can accomplish infinitely more than can be accomplished by ten times the number of persons working without organization and without system.

E. W. BLISS COMPANY.—As a result of its exhibition at the Paris Exposition of presses, dies, shears, drop hammers, and other tools for working sheet metals, the E. W. Bliss Company, Brooklyn, N. Y., advises us that it has received a large number of important orders for its tools, these orders having been received in competition with all of the principal press builders the world over. The E. W. Bliss Company received a grand prize for the excellence of its product. It also advises us that its new plant is about completed. It will be equipped in the most up-to-date manner. A large electric plant and power plant is to be installed. Each floor will have a separate motor for driving the main shafts, while all of the larger machines will be driven by independent motors. Work on the company's new foundry, 200x130 feet, is also well under way.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 16, 1900.
[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

659,655. APPARATUS FOR THE ELECTROLYTIC DECOMPOSITION OF ALKALINE SALTS.; E. Edser, London, England. App. filed March 31. 1899. The invention consists in the provision within an electrolytic cell of a partition composed of a series of troughs, so shaped and disposed as to contain a quantity of mercury, which seals the interstices between the troughs, and so effectively prevents the mixture of the respective liquids contained in the compartments separated by such partition, while permitting by means of the mercury thorough electric communication between the compartments.

659,656. TESTING TRANSFORMERS, Etc.; A. R. Everest, Lynn, Mass. App. filed June 25, 1898. An insulation testing device comprising a step-up transformer, an adjustable spark-gap across the secondary terminals, and terminals for the device to be tested, in parallel with the spark-gap, whereby the latter may short-circuit the dielectric medium of the device to be tested at a determinate potential and prevent discharge through the same.

659,658. ELECTRIC ARC LAMP; R. Fleming, Lynn, Mass. App. filed April 4, 1898. Relates to various structural features of an inclosed arc electric lamp, designed to be used on alternating current circuits.

659,664. SYSTEM OF ELECTRICAL DISTRIBUTION; C. M. Green and J. G. Callan, Lynn, Mass. App. filed June 30, 1900. The commutators of a multi-circuit generator are provided with a plurality of circuits leading therefrom and having an inductive connection between two of the circuits.

659,671. MAGNETIC BLOW-OUT OR FUSE BOX; E. M. Hewlett, Schenectady, N. Y. App. filed April 21, 1900. A cut-out for an electric circuit comprising a magnetic blow-out and auxiliary removable arcing tips projecting in the path of expulsion of the arc gases when the circuit is interrupted, said arcing tips being electrically connected with the circuit terminals.

659,687. ELECTRIC INCANDESCENT LAMP; F. Myers, New York, N. Y. App. filed Sept. 26, 1899. Provides for the opening of the base of the lamp for the removal and replacement of the filaments.

659,691. TELEPHONE TRANSMITTER; G. B. Perkins, Medford, Mass. App. filed Jan. 19, 1900. Relates specifically to the shell which constitutes the electrodes and incloses the granular current varying material.

659,694. HIGH POTENTIAL TROLLEY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed Jan. 11, 1898.

659,697. POWER TRANSMITTING MECHANISM; C. W. Richards and W. W. Chapman, Needham, Mass. App. filed Aug. 17, 1899. For driving dynamos for car lighting systems. The dynamo is located on the floor within the car and driven from the axle by a flexible connection consisting of a series of links connected together by universal joints.

659,705. CLUTCH FOR ELECTRIC ARC LAMPS; H. C. Spinney, Lynn, Mass. App. filed April 4, 1898. A clutch adapted to work very close to the cover of the inner globe and act directly on the carbon pencil.

659,706. GLOBE HOLDER; H. C. Spinney, Lynn, Mass. App. filed March 23, 1899. Details.

659,710. ELECTRIC ARC LAMP; G. E. Stevens, Lynn, Mass. App. filed Nov. 14, 1898. Embodies several improvements which include the structure of the magnets, and provides for ventilation of the magnets.

659,711. ELECTRIC ARC LAMP; G. E. Stevens, Lynn, Mass. App. filed May 31, 1899. Relates to certain structural details, particularly those of the carbon holders and guides.

659,716. ADJUSTING RELUCTANCE OF MAGNETIC CIRCUITS; E. Thomson, Swampscott, Mass. App. filed July 30, 1898. (See page 646.)

659,717. CONTACT DEVICE; E. Thomson, Swampscott, Mass. App. filed May 6, 1899. Adapted for use in arc lamps, and consists of a series of interlinked contact devices such as a metallic chain located in coiled condition within the carbon tube and resting on top of the carbon holder.

659,729. CONTROL APPARATUS FOR ELECTRIC CARRIAGES; H. F. Eaton, Quincy, Mass. App. filed March 25, 1899. Details.

659,759. TELEPHONE EXCHANGE SYSTEM; J. L. McQuarrie, Chicago, Ill. App. filed Nov. 10, 1898.

659,760. HIGH-FREQUENCY TRANSFORMER; C. P. L. Noxon, Syracuse, N. Y. App. filed Feb. 20, 1899. Relates particularly to the sparker for producing and regulating the double spark-gap, and consists of two terminals suitably supported and insulated and a metallic piece easily adjusted to vary its distance therefrom so that at all positions it will be at absolutely equal distances from each terminal.

659,766. AUTOMATIC ELECTRIC CUT-OUT; J. B. Robertson, Morrison, Ill. App. filed June 22, 1899. A cut-out for electric lamps adapted to be actuated at predetermined intervals of time by a spring motor.

659,793. ELECTRIC ALARM SYSTEM AND TESTING APPARATUS; L. H. Des Isles, Cambridge, Mass. App. filed Jan. 10, 1900. Details.

659,768. PILOT SIGNAL FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed March 11, 1897. This invention is a pilot signal for use in switchboards of telephone exchanges designed to be associated with the supervisory signals in the switchboard, the pilot signal being an indicator common to a considerable group of supervisory signals and serving to attract the operator's attention to any supervisory signal which may become displayed, while avoiding the necessity for her constant observation of those signals.

659,789. SIGNAL FOR TELEPHONE TRUNK LINES; H. M. Crane, New York, N. Y. App. filed Jan. 10, 1900. An arrangement of circuits and devices by which the receiving operator may be kept informed of the condition of the trunk line at the switch of the answering operator.

659,823. SUSPENDING DEVICE FOR TROLLEY WIRES; W. A. McCallum, Cincinnati, Ohio. App. filed Feb. 5, 1900. The trolley wire is rolled so as to have a longitudinal groove on either side, and a clamping device has jaws which engage in these grooves. The clamping device is formed in two similar conical members which are held together by being drawn up tightly in a conical socket by a bolt and nut.

659,824. CIRCUIT CONTROLLER FOR ELECTRICAL MECHANISM; W. A. McCallum, Cincinnati, Ohio. App. filed April 17, 1900. Provides means whereby current may be turned on in successive graduated increments without special skill or care on the part of the operator, and comprises a cylindrical hub adapted to fit over and engage with the switch spindle, and a rotating handle seated on the hub and adapted to engage therewith by one or more yielding pawls, and a stop limiting the movements of the handle.

659,828. SYSTEM OF ELECTRICAL DISTRIBUTION; E. W. Rice, Jr., Schenectady, N. Y. App. filed Aug. 16, 1899.

659,829. DYNAMO ELECTRIC MACHINE; W. F. Richards, Buffalo, N. Y. App. filed Jan. 2, 1900. Details of a dynamo adapted for use in electric lighting apparatus for railway cars.

659,855. ALARM MECHANISM; J. C. Meloon, Providence, R. I. App. filed June 5, 1900. A device adapted to be used in connection with fire extinguishers to sound an alarm when the sprinkler is operated. The movement of a member operated by the flow of water closes an electric circuit, and thereby sounds the alarm.

659,873. SNAP SWITCH COMMUTATOR; C. G. Perkins, Hartford, Conn. App. filed June 28, 1900. Embodies a disk of insulating material with a central perforation adapted to receive the rotating means, and conducting pieces that extend from one face over the edge to the other face and are loosely but securely held in position by ears bent into recesses formed in the faces of the disk.

659,882. SPOOL FOR ELECTROMAGNETS; G. L. Weaver, Boston, Mass. App. filed April 30, 1900. In accordance with this invention the outer end of one of the heads of the spool is provided with a recess or magazine to receive a surplus or reserve portion of the inside wire, which can be used if the free end brakes.

659,891. ADJUSTING DEVICE FOR VACUUM TUBES; T. B. Kinraide, Boston, Mass. App. filed Dec. 26, 1899. A vacuum tube is provided with an electrode slidingly mounted in a support within said tube, and a gravity hammer also movably mounted within said tube, the hammer being a ball which may be caused to knock against the electrode and shift it in one direction or the other as desired.

659,926. PROCESS OF MANUFACTURING ABRASIVE MATERIAL; C. B. Jacobs, East Orange, N. J. App. filed May 4, 1900. The process of making a crystalline abrasive from amorphous aluminum hydrate, which consists in heating the hydrate to a state of quiet fusion in an electric furnace and allowing it to cool slowly into a solid mass of crystalline form and a degree of hardness which makes the material suitable as an abrasive.

659,940. TELEPHONE SWITCH; A. Stromberg, Chicago, Ill. App. filed June 13, 1900. (See page 647.)

659,964. ELECTRIC SWITCH; G. H. Whittingham, Baltimore, Md. App filed Feb. 5, 1900. Details of a switch that will, when actuated by a float in a tank, supply current to a motor for operating the pumping mechanism when the water in the tank becomes low, and cut off current when tank has been filled.

659,958. TELEPHONE SYSTEM; W. M. Davis, Chicago, Ill. App. filed June 28, 1900. (See page 645.)

659,959. TELEPHONE EXCHANGE SYSTEM; W. M. Davis, Chicago, Ill. App. filed June 28, 1900. An arrangement of circuits and instruments for testing the condition of called subscribers' lines in multiple-switch board telephone exchange systems.

660,021. ELECTRICITY METER; W. M. Mordey and G. C. Fricker, London, England. App. filed May 19, 1900.

660,043. ELECTRIC FURNACE; W. Borchers, Aachen, Germany. App. filed Dec. 22, 1898. According to this invention the material to be heated is first subjected to a preliminary heating effect and subsequently presented to the fusing zone produced by electrodes and proper electric connections.

660,047. ELECTRIC LIGHTING SYSTEM; J. I. Conklin, New York, N. Y. App. filed March 23, 1900. Details.

660,054. CONTROLLING BRAKE FOR MOTORS; A. C. Eastwood, Ensley, Ala. App. filed May 14, 1900. An arrangement of circuits and devices whereby a braking force may be applied to a motor by causing it to act as a generator, the speed being controlled by varying the resistance in the circuit.

660,057. ASTATIC ARMATURE FOR ELECTRIC SUPPLY METERS; S. Evershed, London, England. App. filed July 21, 1900. An electric supply meter of the motor type is provided with an astatic armature, which consists of coils coupled in succession in the usual way, but having alternate coils wound upon the upper and lower of two formers, upon the motor axle, the coils on the upper former being so connected as to cause the current in them to flow in the opposite sense to that flowing in the lower coils.

660,065. TRACTION SYSTEM; F. J. Sprague, New York, N. Y. App. filed April 30, 1898. (See page 640.)

660,066. METHOD OF REGULATING MOTORS; F. J. Sprague, New York, N. Y. App. filed June 23, 1900. (See page 640.)